DEPARTMENT OF HEALTH & HUMAN SERVICES — Public Health Service

Food and Drug Administration
Rockville MD 20857

FEB 25 1987

Dr. Michael T. Masnik
Acting Director
Three Mile Island-2 Cleanup
Project Directorate
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Masnik:

The Center for Devices and Radiological Health staff has reviewed the Draft Supplement 2 to the Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive waste resulting from the March 28, 1979, accident at the Three Mile Island nuclear station Unit 2 (NUREG 0683, Supplement No. 2, dated December 1986). Our efforts were directed to an evaluation of the public health and safety impacts associated with the proposed alternatives for disposal of water which was contaminated as a result of the accident. We have the following comments to offer:

1. The discussion in Chapter 3 has adequately assessed the alternatives for disposition of the accident-generated water together with the principal environmental impacts for each alternative. It appears that these impacts would involve minimum offsite individual and population dose and occupational dose from releases of tritium, cesium-137 and strontium-90 as a function of the alternative selected.

2. The environmental pathways identified for each alternative covers the possible emission pathways that could impact on the population in the environs of TMI and at potential waste disposal sites. The radiation dose calculation methods and assumptions presented in Appendix B have provided reasonable estimates of the doses to the maximally exposed individual and the population within the 50-mile (80 kilometer) radius of the site. The range of impacts from the alternatives considered are shown in Table 6.1 and indicate that the doses are minimal and well within current radiation protection standards.

3. The discussion in Section 5.2 has adequately assessed the radiological impacts and health effects to the workforce population, the maximally exposed individual, and the offsite population within 50 miles (80 kilometers) from exposure to radioactive effluents. We unequivocally concur with the statement in Section 5.2, page 5.5, paragraph 2, that states "These risks are very small in comparison to cancer incidence from causes unrelated to the disposal of the accident-generated water."

C002
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4. Some of the alternatives for disposal of accident-generated waste involve offsite truck shipments. Consequently, it is possible to estimate the number of non-radiological fatalities and injuries that are likely to occur. We agree absolutely with the conclusion in Chapter 6 that the most significant potential impact associated with any disposal alternative is the risk of physical injury as a result of a transportation accident.

Thank you for the opportunity to review and comment on this Programmatic Environmental Impact Statement.

Sincerely yours,

John C. Villforth
Director
Center for Devices and
Radiological Health

RECEIVED MAR 2 1987

44 Carriage Lane
Annapolis, Md.21401
February 22, 1987

The Honorable Arthur E. Morris
Mayor of Lancaster
P.O. Box 1559
120 N. Duke Street
Lancaster, Pa. 17108

Dear Art,

I regret to have to miss the upcoming meeting of the TMI Advisory Panel. I will be on business travel to the west coast Mon. through Friday.

In reading the transcript of the Jan. 21,1987 meeting I noted that the alternative of ocean disposal of the cleaned-up accident residual water was not completely considered.(See page 22) The reason cited was an international moratorium on the ocean disposal of any radioactive material. It struck me odd and perhaps a source of confusion for the public that on one hand Federal authorities do not consider release of the water to the Susquehanna a significant health risk yet the U.S. is reportedly a party to a moratorium that would exclude ocean disposal. What goes??

I made a few phone calls and did a little library research. I learned enough to convince me that this alternative should be examined more thoroughly than it seems to have been. Let me share with you and the panel a brief summary of the current ocean disposal situation as I understand it.

The United States is a signatory to the international "Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter". This Convention is also referred to at times as the London Dumping Convention. This Convention was developed in 1972 and was ratified by the U.S. in 1975. Under the terms of this Convention , ocean dumping of a group of materials considered particularly hazardous is prohibited. Included in this group(Annex I) are"high level radioactive wastes or other high-level radioactive matter". The use of the ocean for disposal of low-level radio active wastes is not prohibited by the convention but such dumping "requires a a prior general permit".

The U.S. did permit a limited amount of ocean disposal of low level radioactive waste in drums years ago but this practice was stopped,largely because of both national and international sensitivities about use of the oceans for such purposes. With the availability of alternate means, such as shallow land disposal, there has been no need for generators of low-level wastes in the U.S to press for ocean disposal. Other countries less endowed with land they are willing to dedicate to such use have been studying the technical and environmental implications of ocean disposal of ~~ant health risk yet~~
~~the U.S. a party to a moratorium that would exclude~~
~~ocean disposal. What goes??~~

I ~~made a few phone calls and did a little library~~
~~research. I learned enough to convince me~~ have shown no technical reasons for precluding this method of disposal, there remains considerable uneasiness on the part of some countries to endorse the practice. In 1985, delegates to the London Dumping Convention voted to suspend low-level dumping waste exercises pending completion of an experts' study. The study proved inconclusive. In September 1985,at a similiar session,the London Convention passed a resolution for the continued banning of ocean dumping of low-level radioactive waste. This was a non-binding resolution. The United States joined with the U.K., Canada, France, South Africa,and Switzerland in voting against the resolution. The United States delegate nonetheless did state that the U.S. had no plans for ocean disposal.

An official at the EPA advised that the Agency currently has no rules in place that spell out the criteria that would apply for getting a general permit as prescribed by the Convention. However,it is possible such guidance may be forth coming next year.

It may well be that the ocean disposal alternative may not be viable given the time frame for making decisions about the TMI water. Nonetheless, it seems to me enough positive possibilities that it should not be put in shelf without closer scrutiny.

Respectfully,

Joseph J. DiNunno

P.O. Box 983
Pierre, South Dakota 57501
February 21, 1987

Dr. Michael T. Masnik
TMI Project Directorate
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Comments on Draft Supplement #2, NUREG-0683, Programmatic Environmental Impact Statement related to Decontamination and Disposal of Radioactive Wastes resulting from March 28, 1979 Accident, Three Mile Island Nuclear Station, Unit 2, Docket #50-320 (December 1986)

Dear Dr. Masnik:
I have reviewed this draft supplement and wish to make the following comments.

In the Summary on page v, I note that the disposal volume of accident-generated water was "expected to be 40,000 to 80,000 cubic feet (11,000 to 13,000 cubic meters)". I believe that cubic feet have been converted here into square meters and not cubic meters.

In the second paragraph of the Summary, I see that the final processing will involve about 2.1 million gallons, or 7.9 million liters with about 1,000 curies of tritium and smaller amounts of cesium 137 and strontium 90. There is no mention here of uranium, plutonium or other transuranics, nor of other of the 500 different radionuclides of potential importance in the assessment of contamination around nuclear facilities. This is a very serious oversight. I believe that the concentration of all of these should be determined.

The Summary estimates that the considered disposal alternatives will have an impact of only 0 to .003 radiation-induced cancer deaths in the worker population and only 0 to 0.0003 for radiation-induced cancer fatalities in the offsite population. If this water is really that innocuous, should the plant save it to be used in drinking water fountains for the employees at the plant? Or should it be carbonated, bottled, and sold in stores as spring water?

COO2
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As I recall, the reactor core in this plant was partially melted down and this water has been in and around the 100 tons of partially melted uranium (with plutonium and other activation and fission products) for nearly seven years. Many of these metals and compounds are quite water-soluble, especially uranium. The Schwarzwalder Uranium Mine, for example, near Golden, Colorado, at times pumps out more than a million gallons of water each day, and in the past (perhaps today also) this has been discharged into public water supplies. The water at times contains more than 10,000 picocuries per liter of alpha radiation from the uranium. The contact there between water and uranium ore has been at rather cool temperatures, not in a super-heated environment such as has occurred at TMI-2. I can't believe that there is not a large amount of uranium and its progeny and other transuranics dissolved in this water in TMI-2. And yet, in reading this report I didn't see any mention of alpha radiation levels per liter of water nor of the concentration of uranium and other transuranics in the water.

In the manuscript there was a discussion of background radiation levels in surface waters downstream and these discuss the levels of alpha radiation and radium in the water amounting to several picocuries per liter. The lack of information in this draft report on the concentration of uranium and transuranics in the waste water is very puzzling.

The range and concentrations of radionuclides in the water should be determined by number of agencies and independent laboratories, and the radiation protection guides should be those developed by the EPA or by more conservative independent researchers. For example, the EPA has advised a limit of 10 picocuries per liter of uranium in water, in contrast to a limit of 6000 supported by the Dept. of Energy. Further, the units in the book should be consistent with present EPA practice. After all, this is an environmental impact statement. Radiation activities should be expressed in terms of picocuries per liter of water and picocuries per cubic meter of air. The use of

awkward units like microcuries per milliliter and the use of large negative exponents should be avoided,since these are confusing even to experts and especially confusing to the public.

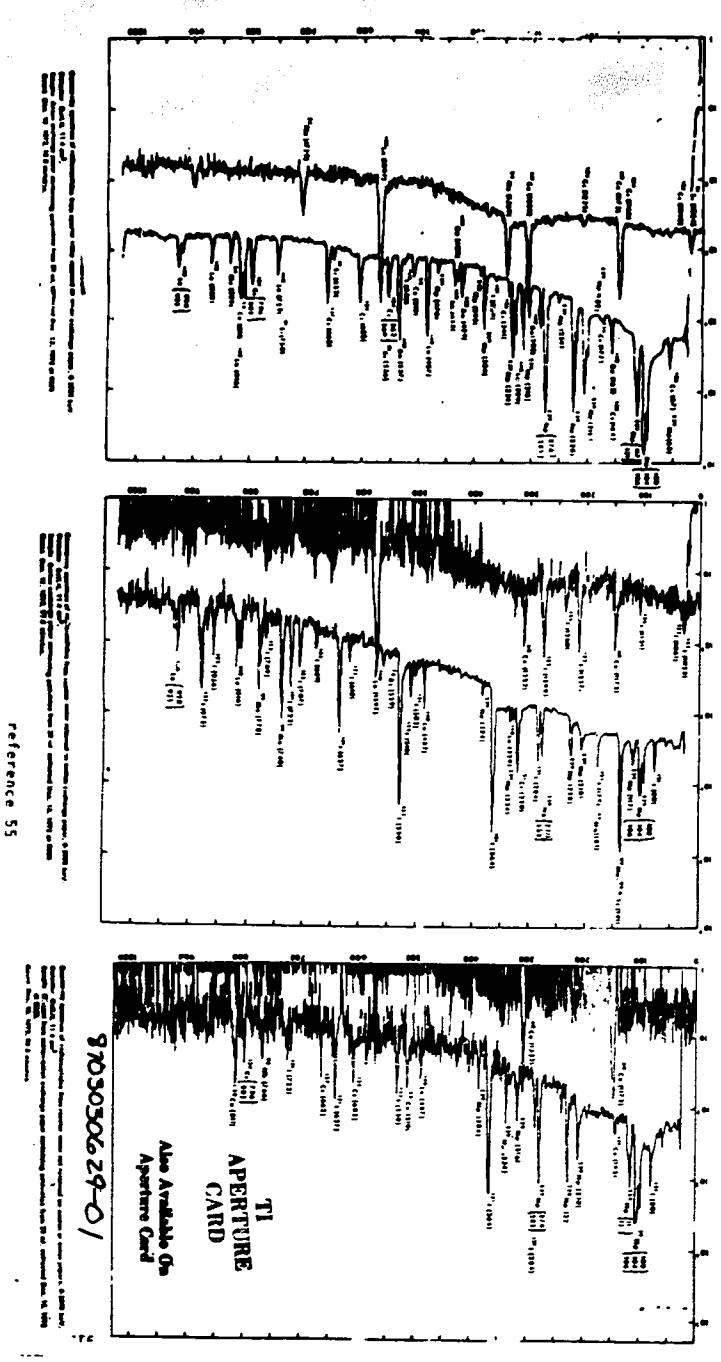
In several places the text reads as if the tritium in the water is there as the gas. In fact, tritium (which is hydrogen) oxidizes with oxygen and ozone over time to form tritiated water or heavy water. The evaporation process will simply evaporate off all the tritium as tritiated vapor which is much more toxic on inhalation or ingestion than is tritium gas.

I think that we do not have enough information to make a decision about the disposition of this water. I recommend against any of the methods of disposal at this time, until there has been exhaustive analyses of the water by a number of agencies and independent laboratories at universities, including one or two in Canada. The water should be analyzed also, for example, by the EPA and by the U.S. Geological Survey, which does get involved in what happens to water in the environment. I have attached a figure from an EPA report on liquid emissions from a nuclear power plant in normal operation to show the range of radionuclides released in such normal operations.

I think we need to know more about the assumptions made in calculating doses to persons around the plant from the radionuclides which might be released by the various alternatives proposed. Those dose estimates should also include exposure to every one of the 500 radionuclides of potential importance in this water, and should also consider concentrations of radionuclides by marine plants and animals in the food chain.

Sincerely,

Carl J. Johnson, M.D., M.P.H.



reference 55

Figure 24

GPU Nuclear

GPU Nuclear Corporation
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4410-87-L-0032
Document ID 0165P

March 17, 1987

Michael T. Masnik
Three Mile Island Cleanup Project Directorate
Office of Nuclear Reactor Regulations
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Masnik:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Comments of Draft Supplement 2 to the
Programmatic Environmental Impact Statement - Three Mile Island Unit 2

The purpose of this letter is to provide GPU Nuclear comment on Draft Supplement 2 to the Programmatic Environmental Impact Statement - Three Mile Island Unit 2 (PCIS). In addition to the detailed comments provided herein, the information provided in GPU Nuclear letters 4410-86-L-0018 dated February 3, 1987, and 4410-87-L-0023 dated February 18, 1987, should be considered as an integral part of our comments on Supplement 2.

Sincerely,

/s/ F. R. Standerfer

F. R. Standerfer
Director, TMI-2

FRS/JJB/eml

Attachments

cc: Director - TMI-2 Cleanup Project Directorate, Dr. W. D. Travers

ATTACHMENT 1
4410-87-L-0032

COMMENTS TO THE DRAFT SUPPLEMENT 2 TO THE
PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT - THREE MILE ISLAND UNIT 2

1. Summary, page VI - Radiation-induced cancer fatalities in the off-site population is different from that listed in pages 5.5, 6.1 and 6.2 of the report.

2. Nomenclature, page XXVI - Tritium contains three nucleons vice neutrons.

3. Section 2.2, pages 2.3 and 2.4 - The discussion about drinking the processed water should be deleted. The doses given in Table 2.3 for drinking the processed water may be confusing to the public.

4. Sections 2.2.1, 2.2.2 and 2.2.3, pages 2.5, 2.6, 2.7 and 2.9 - These sections include good discussions about the characteristics, interactions, and environmental concentrations of the radionuclides to be released. If additional radionuclides are added to the inventory list, as a result of the information provided in GPU Nuclear letters 4410-87-L-0018 and 4410-87-L-0023, the PEIS should be amended to include similar discussions about the additional radionuclides.

5. Section 2.2.3.2, page 2.9 - The typical dietary intake of strontium should include a time period, e.g., 1.9 milligrams/day vice 1.9 milligrams.

6. Section 2.2.3.3, page 2.9, first paragraph - Background levels of Sr-90 are "routinely" measured, rather then "rarely" measured.

7. Section 2.2.5.3, page 2.12, second paragraph - "Very low concentrations are also detrimental." should be, "Excessively low concentrations are also detrimental."

8. Section 3.1.1, page 3.3 - Should note that evaporator bottoms may be in the form of a dry powder, in which case solidification will not be required; dry powder disposal may be in drums.

9. Section 3.1.1.1, page 3.3 - Should indicate that the evaporator is modular vice transportable, i.e., the evaporator may not be transportable as a single unit. It may require several modules to be transported to the site for assembly.

10. Section 3.1.1.1, page 3.3, first paragraph - Should change the sixth sentence of this section to read, "Some form of moisture separator or vapor superheater would be provided to assure that liquid droplets and dissolved components are not discharged with the water vapor."

11. Section 3.1.1.1, page 3.3; Section 3.1.1.2, page 3.6 - Although the original GPU Nuclear proposal anticipated that exhaust from the evaporator would be routed to an existing atmospheric discharge point, this plan has been modified. It is anticipated that a separate exhaust stack (currently anticipated to be 100 feet high) will be installed with the evaporator.

12. Section 3.1.1.1, page 3.3 - Although the original GPU Nuclear proposal assumed a 3 gal/min flowrate for the evaporator, it should be noted that higher flow rates are acceptable if evaporator effluents comply with Technical Specifications Limits.

13. Section 3.1.1.1, page 3.6; Section 4.5, page 4.12 - Should indicate that the low level waste (LLW) may be shipped to any commercial LLW burial site and that the U.S. Ecology site near Richland, Washington, was specifically evaluated as it was judged to be the bounding case from a transportation accident standpoint.

14. Section 3.1.1.2, page 3.7, third paragraph - The annual dose values stated (e.g., "dose to the maximally exposed individual is estimated to be 0.9 mrem to the bone and 0.2 mrem to the total body") do not appear to be correct. This annual dose appears to result in a 50-year dose commitment higher than 3 mrem to the bone and 0.5 mrem to the total body.

15. Section 3.1.2.2, page 3.12, third paragraph - The person-rem to the bone (2 person-rem) is less than the person-rem to the total body (3 person-rem). However, the bone dose to the maximally exposed individual is higher than the total body dose. There appears to be an error in the person-rem numbers.

16. Section 3.2.1.2, page 3.16, first paragraph - Should include an assessment due to airborne dispersal of solids.

17. Section 3.2.1.3, pages 3.16 and 3.17 - Should also include a dose from the groundwater pathway.

18. Section 3.5.1, page 3.31 - EPA drinking water standards for Sr-90 and Cs-137 are not mentioned.

19. Figure 4.4, page 4.5 - Population distribution is not the same as used by TMI. The population distribution used by TMI is provided in Attachment 2.

20. Section 4.1.3, page 4.9 - Normal groundwater elevation is closer to 282' MSL average.

21. Section 4.2.2., page 4.11 - Other endangered species occur in the TMI vicinity. For example, ospreys have been observed around the York Haven impound pond by TMI personnel. Paragraph should indicate that other endangered species may visit the site.

22. Section 5.2, page 5.4 - References to BEIR I and BEIR III are confusing. The section should clarify the intended use of each report.

23. Appendix B, page B.1 and Section 3.1.1.3, page 3.9 - Chester County and Baltimore City have water intakes in the Susquehanna River. Although they generally do not use Susquehanna River water, that potential exists. Therefore, TMI uses 6 million persons for the total population, including these large metropolitan areas. Since the possibility exists that these two water sources could be in use for short periods of time, accident calculations should include these populations.

ATTACHMENT 1
4410-87-L-0032

24. Section 3.4.2.2, page 3.29 - What river discharge flowrate is used? Since river flowrate is an important factor in population dose, a short term release could be deliberately conducted during high river flow to reduce population dose. The option should discuss the potential reduction in population dose commitment with proper timing of the release (i.e., at spring flood).

25. Appendix B, page B.1 and Section 5.1, page 5.1 - Doses to the population should include the entire fed population in the 50 mile radius. Lancaster County has one of the highest foodstuff value productions by county in the entire country. Therefore, export of these foodstuffs should be considered. It is inconsistent to incorporate the questionable bay shellfish pathway and not the fed population within 50 miles. While the resident population is about 2.2 million people, the fed population can approach 15 million people.

26. Appendix B, page B.1 and Section 5.1, page 5.1 - TMI used 6 million persons as the drinking water population. Some discussion of the size of the potentially exposed population in Chester County and Baltimore City would be appropriate.

27. Appendix B, page B.1 - The river flowrate given here should be included in the discussions in the body of the report.

28. Appendix B, page B.1 - A near field dilution factor of 0.2 is appropriate for the fish pathway, based on Regulatory Guide 1.109 and TMI/Sutron dye studies of the Susquehanna River. Why has a flow of 3150 cfs been used for the fish pathway only?

29. Appendix B, page B.2 - Inclusion of the Bay shellfish pathway is inappropriate. There is clearly a dramatic dilution in the bay. The behavior of Susquehanna River water in the bay is not modeled. Surely channel flow of the lighter freshwater, dilution in the bay, flushing by tidal action, and input from other rivers (Chester, Patapsco, Potomac, Choptank) make the calculation grossly inaccurate. Further, many shellfish grounds are in tributary waters which may not be impacted by Susquehanna River water. Finally, long hold up times in the impounds of the numerous dams downstream contribute to natural removal processes.

30. Appendix B, page B.3 - Input ingestion parameters for the concerned population do not appear to be consistent with Regulatory Guide 1.109.

31. Appendix B, page B.3 - Annual 50-mile radius production figures are not consistent with those used at TMI; i.e., approximately 2×10^8 kg/yr meat, 2×10^9 kg/yr vegetables and 2×10^9 l/yr milk.

32. Appendix B, page B.3 - The pathway fractions are inconsistent with those used at TMI. Based on the annual land use census, most milk and beef animals are on pasture for about 7 months of the year.

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33. General - The total amount of processed water at TMI-2 is increasing at a faster rate than originally predicted. This increase is due to the use of demineralized water for various plant processes that were not originally anticipated (e.g., demineralized water has been borated to requried RCS concentration for use in the coagulant addition system). GPU Nuclear now anticipates that approximately 2,300,000 gallons of water will require evaporation. However, since this additional water was uncontaminated prior to use at TMI-2, the amount of radionuclides available for release from TMI-2 remains constant.

ATTACHMENT 2
4410-87-L-0032

POPULATION AFFECTED BY GASEOUS PATHWAY PEOPLE

DIRECTION S (DOWN WIND)				
3.000E+01	3.600E+01	4.340E+02	6.680E+02	4.640E+02
8.307E+03	7.401E+04	2.036E+04	8.542E+04	1.034E+05
DIRECTION SSW (DOWN WIND)				
1.500E+01	4.100E+01	3.040E+02	4.160E+02	3.870E+02
3.975E+03	1.910E+04	4.263E+04	2.490E+04	4.179E+04
DIRECTION SW (DOWN WIND)				
1.500E+01	1.130E+02	3.200E+02	4.480E+02	5.160E+02
3.416E+03	1.219E+04	1.320E+04	2.249E+04	2.250E+04
DIRECTION WSW (DOWN WIND)				
1.400E+01	2.370E+02	3.200E+02	4.480E+02	5.760E+02
3.467E+03	1.284E+04	1.301E+04	1.877E+04	2.188E+04
DIRECTION W (DOWN WIND)				
1.800E+01	3.330E+02	3.200E+02	4.480E+02	5.820E+02
5.453E+03	1.362E+04	4.265E+04	3.250E+04	3.789E+04
DIRECTION WNW (DOWN WIND)				
1.500E+01	2.510E+02	3.060E+02	4.640E+02	5.990E+02
8.121E+03	3.209E+04	1.464E+04	1.166E+04	8.473E+03
DIRECTION NW (DOWN WIND)				
1.300E+01	1.210E+02	1.690E+02	2.590E+02	1.814E+03
2.986E+04	6.215E+04	8.230E+03	1.018E	1.066E+04
DIRECTION NNW (DOWN WIND)				
9.000E+00	5.700E+01	1.275E+03	8.290E+02	1.093E+03
1.662E+04	1.281E+04	1.803E+04	1.597E+04	1.750E+04
DIRECTION N (DOWN WIND)				
7.000E+00	8.100E+01	3.104E+03	5.654E+03	1.779E+03
1.326E+04	1.274E+04	2.319E+04	4.198E+04	3.055E+04
DIRECTION NNE (DOWN WIND)				
3.000E+01	1.332E+02	2.720E+02	3.240E+02	3.980E+02
9.264E+03	1.484E+04	2.457E+04	1.972E+04	4.388E+04
DIRECTION NE (DOWN WIND)				
8.000E+01	1.330E+02	2.210E+02	3.100E+02	3.980E+02
4.202E+03	2.229E+04	2.553E+04	1.967E+04	7.477E+04
DIRECTION ENE (DOWN WIND)				
3.700E+01	1.330E+02	2.210E+02	3.100E+02	3.880E+02
2.336E+03	1.630E+04	2.776E+04	3.575E+04	1.585E+05
DIRECTION E (DOWN WIND)				
4.000E+01	1.170E+02	2.210E+02	4.250E+02	5.010E+02
1.068E+04	3.074E+04	3.684E+04	3.432E+04	4.745E+04
DIRECTION ESE (DOWN WIND)				
3.700E+01	1.040E+02	1.600E+02	2.900E+02	4.960E+02
3.693E+03	3.787E+04	9.597E+04	4.031E+04	5.821E+04
DIRECTION SE (DOWN WIND)				
3.400E+01	1.030E+02	1.600E+02	2.200E+02	2.790E+02
2.444E+03	2.158E+04	2.215E+04	3.273E+04	3.435E+04
DIRECTION SSE (DOWN WIND)				
2.500E+01	8.600E+01	1.650E+02	3.110E+02	2.280E+02
3.678E+03	1.862E+04	2.228E+04	2.986E+04	5.910E+04

DISTANCES (METERS) FOR ABOVE TABLE				
6.100E+02	2.413E+03	4.022E+03	5.631E+03	7.240E+03
1.207E+04	2.414E+04	4.023E+04	5.632E+04	7.241E+04

Department of Energy
Washington, DC 20585
March 31, 1987

Mr. William D. Travers
Director
TMI-2 Cleanup Project Directorate
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
P.O. Box 311
Middletown, Pennsylvania 17057

Dear Mr. Travers:

This is in response to your letter of December 29, 1986, that forwarded Draft Supplement 2 to the Three Mile Island Unit 2 (TMI-2) Programmatic Environmental Impact Statement for the Department of Energy's review and comments. The Draft Supplement addresses potential environmental impacts associated with the disposal of radioactively contaminated water resulting from the TMI accident that currently is stored at the TMI site.

The Draft Supplement includes the evaluation of 10 alternatives, summarized in Table 3.1, with respect to: (1) systems and operations required for implementation; (2) estimated environmental impact, including risk of radiation exposure to the public and to workers; (3) probability and consequences of accidents; (4) commitment of resources, including cost; and (5) regulatory constraints.

Based on this evaluation, the Nuclear Regulatory Commission (NRC) staff concludes that the accident-generated water can be disposed of without significant environmental impact, and that among the alternatives evaluated, no alternative is clearly preferable. Estimated radiological risks to the general public are very small fractions of estimated normal incidence of cancer fatalities and genetic disorders. The most significant potential impact is the risk of physical injury in the event of transportation accidents for those alternates involving offsite disposal. One of the alternatives, involving indefinite continuation of liquid storage at the TMI site, is considered inappropriate because it simply defers the ultimate decision on disposal. The GPU Nuclear Corporation (GPUNC) already has proposed to the NRC the alternative involving evaporation and solidification of bottoms at the TMI site and disposal at a commercial disposal site.

Three of the alternatives evaluated involve disposal of the TMI contaminated water at a DOE facility, either Hanford or the Nevada Test Site (NTS). Of these alternatives evaporation from a specially lined pond at the NTS may be a feasible alternative;

however, neither disposal by deep well injection at NTS nor crib disposal at the Hanford site should be considered as reasonable alternatives.

DOE policy, embodied in Order 5820.2, issued February 6, 1984, states that disposal operations involving discharges of liquid low-level waste (LLW) directly to the environment or on natural soil columns shall be replaced by other techniques, such as solidification prior to disposal or in-place immobilization, unless specifically approved on a case-by-case basis. In addition, the Office of Environment, Safety and Health is committed to encouraging and supporting activities related to discontinuing the practice of discharging contaminated liquids to the ground. Further, if liquid LLW were disposed to units such as cribs or injection wells such units would be potential sites under the Comprehensive Environmental Response, Compensation, and Liability Act, which may require characterization studies to determine the need for remedial actions to prevent or minimize the release of hazardous substances, including radionuclides, to the environment. Consequently, the alternatives involving direct discharge to the soil through cribs at Hanford or injection wells, at NTS should be eliminated from further consideration.

As stated in the EIS, the alternatives involving offsite shipment of the water or the "solidified water" (without prior evaporation) would result in an estimated number of traffic accidents much higher than the other alternatives because of the greater quantity of shipments. Moreover, the solidification-offsite shipment alternative results in a total waste volume an order of magnitude or more higher than that for the other alternatives. For these reasons, we believe the environmentally preferred alternative appears to be onsite evaporation.

Please find enclosed a list of technical comments to assist you in revising the draft EIS.

Yours truly,

Mary L. Walker
Assistant Secretary
Environment, Safety and Health

Enclosure

ENCLOSURE

DOE Technical Comments for TMI-2 EIS Related to Decontamination and Disposal of Radioactive Wastes Resulting from March 28, 1979 Accident

1. There appear to be errors on Table 2.5 in the tritium concentration values. The correct value for both soluble and insoluble forms of tritium as taken from the NRC regulation 10 CFR Part 20 is 3 x 10^{-3} mCi/ml.

2. Quantification of air dispersion and water dilution would further the arguments on minimal environmental impacts associated with the evaporation and river discharge options. In the case of river discharge a calculation of the concentration of the pertinent isotopes at the point(s) of water supply intake and at the tap would be most useful. All assumptions used in these calculations should be provided in the EIS.

3. Appropriate DOT regulations for transport of radioactive material should be referenced and discussed in relation to the alternatives involving transportation.

4. Similarly, the document should explain the status of agreements/consultation with DOE concerning use of DOE facilities for waste disposal, to help the reader understand the extent to which these are realistic alternatives.

5. Doses and risks for an accident involving contaminated water should be quantified. Table 5.1 includes no offsite dose for options 3.2.1 - 3.2.3. However, a single truck accident could lead to potential exposures higher than any others in the table.

6. The format for discussing the treatment options, system and operation, estimated environmental impacts, potential accidents, and regulatory constraints is excellent. Very little was said about required environmental monitoring for each option e.g., water table wells, establishment of background conditions at selected disposal sites, and stream and river sampling.

7. The summary should include Table 5.1. This is the alternative impact summary of the report and is the information a decision will be based upon.

8. The "achievable" column in Table 2.2 could be accompanied by more explanation from the text.

THE ADVISORY PANEL FOR THE DECONTAMINATION OF THREE MILE ISLAND UNIT 2

March 31, 1987

Vice Admiral Lando W. Zech, Jr.
Chairman
Nuclear Regulatory Commission
Matomic Building
1717 'H' Street, N.W.
Washington, D. C. 20555

Dear Chairman Zech:

A meeting of the NRC's Citizen Advisory Committee for the Decontamination of Three Mile Island Unit II was held on Wednesday, March 25, 1987. The purpose of the meeting was to receive public testimony and comment on the Draft Supplement to the Environmental Impact Statement dealing with the disposal of accident-generated water and the disposal option of on-site evaporation recommended by GPU. This meeting, which was a continuation of a 5-hour session held in Lancaster, Pennsylvania on February 26, began at 6:00 p.m. and concluded shortly after 11:00 p.m.

At both of these meetings virtually all public comment was in opposition to the proposed evaporation plan put forth by the operator. Continued storage in the holding tanks on the island was the preferred option put forth by most citizens. The public, in stressing this option, expressed distrust of GPU's operation of the plant in general and the evaporation in particular, together with the strong feeling that the area around the plant had already received radiation exposure from the accident and subsequent cleanup and did not want to add any additional exposure, at any level.

GPU testified that any one of a number of alternatives reviewed would safely do the job and that on-site evaporation was their recommended alternative. They stressed that they were very sensitive to community concerns and that is why the discharge to the Susquehanna River was not given strong consideration.

The NRC staff outlined the work that they had performed in completing the Draft Supplement EIS. The staff stressed that no alternative was found to be clearly preferable and that the total quantified impact of any alternative is very small. According to the staff, the most significant potential impact associated with any disposal alternative is the risk of physical injury associated with transportation accidents. Lastly, NRC staff stated that indefinite on-site storage is inconsistent with the Commission's policy that the cleanup, including the removal of radioactive wastes from the TMI site, be carried out safely and expeditiously.

Following the receipt of these comments, the Panel then attempted to develop a consensus on the issues for recommendation to the Commission. The following motions were considered by the Panel:

1) A motion that "the Draft Supplement to the Environmental Impact dealing with the disposal of the accident-generated water is an acceptable document" passed with a vote of eight (8) for and two (2) against.

2) A motion to "oppose the evaporation option" put forth by GPU was passed with a vote of five (5) for, four (4) against and one (1) abstention.

3) A motion to "maintain the status quo until a stronger case can be made for definitive action, including evaporation or a more desirable alternative" was not approved due to a vote of five (5) for and five (5) against.

The Panel devoted a considerable amount of time to the water disposal matter. I have attempted to summarize what happened at our meetings of February 26 and March 25. In order for the Commission members to get the total picture, the Panel would encourage you to review the entire transcripts of these meetings.

We look forward to meeting with you at 11:00 a.m. on April 16 in Washington; this will provide us with a further opportunity to discuss this subject, which is of considerable importance to the clean-up effort. Unfortunately, due to a long-standing commitment, I will be unable to join you in Washington. However, it is expected that the Panel will be well represented by ten (10) of our members; Joel Roth will act as the chair.

Please feel free to contact me should you have any questions in regard to this letter.

Sincerely,

Arthur E. Morris

Arthur E. Morris, Mayor.
Chairman

AEM/dk

cc: Mike Masnik
All Panel Members

TMIA: THREE MILE ISLAND ALERT, INC.
315 Peffer St., Harrisburg, Penna. 17102 (717) 233-7897

QUESTIONS CONCERNING THE NRC's REVISED EIS ON THE DISPOSAL OF RADIOACTIVE WATER

Q1:p.2.6 (p.3.1 & p.5.6 second paragraph).Second paragraph. "There is no evidence for a significant concentrartion process for tritium in either plants and animals". (NCRP '79). "No apparent enrichment or concentration effect for tritium has been found in aquatic or terrestial food chains." (NCRP '79). Does no concentration mean no adverse health effects? Are there are any studies that contradict these findings? Was this study the sole basis of your reporrt concerning tritium and its interaction with biological systems? If so, why?

Q2: p.2.11 What levels of boric acid or boron in the water would cause you concern? Also refer to last paragraph p3.28.

Q3: p.2.13 When was the EPA's NIPDWS drafted? Was it ever revised? Same ? for RCRA.

Q4: p.2.15 Since Pennsylvania is a non-Agreement state, and is bound by the NRC's decision, what recourse is left to the state or citizens who are dissatisfied with the NRC's decision? Can a decision be binding even if it violates other Pennsylvania environmental laws ? What if Pennsylvania becomes an Agreement state before the water issue is reolved? What bearing will that have on the process?

Q5: P.3.1.1.1 Why not let the transportable evaporator operate in closed cycle? How accurate has the volume reduction figure been in 3.1.1.2 at other plants? What if it is skewed a few magnitudes?

Q6: p.3.7 Do the maximum dose rates assume that all plant, aquatic and human life are chemically and radicactively pure before their exposed to the radioactive emissions from the water?

Q7: Do any of your cost breakdowns take into account inflation, regulatory/legal delays (3.1.1.4) logistical delays, etc. How much of a factor is economics when you analyze the alternatives?

Q8: p.3.1.2 & p3.10 Second paragraph. Would the NRC allow GPU to place concreted waste in a trench on site? Sixth paragraph. When is the NRC going to consider long-range monitoring at TMI?

Q9: p.3.10 What is a Hypalon cap? Is it any relation to the disasterous clay cap used at chemical sites in California?

Q10: p.3.12 Would DER allow unrestricted use of site after 30 years? p.3.13 You would have no problem w/ building or farming on this site after 30 years? Who will monitor the site?

Q11: p.3.15 Last paragraph. How do you assure that no civilians are upwind?

Q12: p3.22 First paragraph. How do you monitor the 50% tritiated water, and keep it separate from the 50% that is not monitored? Does this mean that the other 50% will not be monitored?

Q13: Why has the NRC adopted the De Minimis Waste Impacts Analysis Methodology? Are there methodologies that contradict or call into question the De Minimis methodology?

Q14: p.3.24 What if no LLW burials ite wants the waste? What if GPU doesn't want to use their alloted space at a site for the disposal of this waste?

Q15: p3.4.1 Will the release be publicized before disposal? 3.4.1.2 How are you so sure all exposures will be diluted? What guarantees exist to prevent GPU from adding more highly radioactive water before disposal? What will the NRC monitor? And how?

Q16: p. 3.4.2.3 Accident analysis. Why is a discharge of a batch of accident-generated water before treatment unlikely?

Q17: p3.31 What is meant by "ultimate disposal"? p.3.5.1.2 No other expected pathways of exposure to public?

Q18: p3.5.1.4 Why are no other impediments expected before license termination?

Q19: p.5.3 The environmental, health, economic and human costs associated w/the no action alternative is minimal. Why not endorse it?

Q20: p.5.4 Third paragraph. What is meant by "...biological mechanisms that can repair damage caused by cancer at low-levels".

Q21: Is there an endpoint to this process? Does the process end precisely at 2.1 million gallons of water? If so, what happens to additional water?

Q22: Why was there no meteorological study conducted?

TMIA: THREE MILE ISLAND ALERT, INC.
315 Peffer St., Harrisburg, Penna. 17102 (717) 233-7821

TMIA'S COMMENTS TO THE NRC ADVISORY PANEL ON THE NRC'S REVISED EIS ON THE DISPOSAL OF RADIOACTIVE WATER

In that this is a very sensitive subject I think the Panel should not rigidly enforce time constriants on questions and presentations by the community. In addition, I hope the water disposal issue does not become a secondary item after this meeting.

I appreciate the fact that GPU responded to my questions concerning Post Defueling Monitored Storage. However, I'm not satisfied with a number of the responses, especially the ones dealing with decommissioning. Rather then pursue a line of questioning tonight, I'll defer until the next meeting.

I am submitting a list of questions to the NRC concerning their revised EIS. I request that they be made a part of the official record. I'm speaking tonight on behalf of Three Mile Island Alert, which is a non-profit, safe energy group based in Harrisburg.

Both the NRC and GPU have stated that the quantities of radiation released during the disposal of the contaminated water would be "insignificant." They always says this! We don't believe that any radiation dose is safe, especially in this area where radiation has been vented steadily for the last 14 years. I don't remember a time when the utility admitted that "significant" levels of radiation have been released, including the 43,000 curies of Krypton-85 vented on Central Pennsylvania for 13 days in July 1980.

We have serious reservations about the disposal options sanctioned by the NRC. In fact disposal is an incorrect term. There will be no actual disposal, and no guarantee of containment. Instead, radioactive materials and industrial chemicals will be dispersed in the environment. We do however, have certain objectives we would like to see met.

- Our prime and overriding concern is minimzing radiation exposure to the local population and the environment. For example, we would like to see 100% of the water filtered and processed within a closed cycle.

- Worker exposure should be minimized, since many of them have human sponges for the last 7 and 1/2 years.

- Dose rates to populations outside of central Pennsylvania should also be minimized.

- Cost and time should not be factors. GPU should spend as much money and take as much time as needed to find the safest method of disposal.

Considering these objectives, alternatives such as dumping the water into the Susquehara River and on-site evaporation are clearly unacceptable, due to the potential harmful physical and psychological threat they present to our community.

We request the following steps be taken before a final decision is made: a meteorological study of the area surrounding TMI; a study examining the psychological stress that would result from the planned disposal methods; an inventory of all the radioactive elements and chemicals that are in the water; and a review of the GPU's current proposal and the NRC's revised EIS by an independent agency not affiliated with the nuclear industry or the government.

At this time I'd like to remind the panel of some of the past behavior of this utility and the NRC, because this is a crucial factor in understanding the built in distrust and fear of area residents.

We remember that in July of 1980, 43,000 curies of radioactive krypton-85 and other radioactive gasses were vented from Unit-2, even though TMI-2 was designed to release approximately 770 curies of krypton-85 a year. The venting occurred a little over a year after the the accident admidst widespread fear and concern. Later, in November the U.S Court Of Appeals for the District of Columbia ruled in Sholly vs. the NRC that the krypton venting was illegal.

We remember that in the spring of 1983, three senior level engineers charged that GPU and Bechtel deliberately circumvented safety procedures and harassed them for reporting safety violations. The NRC fined GPU and Bechtel $64,000 for intimidating and harassing Larry Parks.

We remember the reactor head lift between July 24 - 27, 1983, which was delayed due to brake failure on the polar crane. GPU vented radioactive gases into the environment, despite pledges by the NRC and GPU that no venting would take place during the head lift operation. GPU was later fined $40,000 by the NRC for the brake problem.

We remember that on June 1, 1984, the NRC released transcripts of closed NRC Commission meetings. The transcripts revealed a commitment on the part of a Commission majority to restart TMI-1 as soon legally and politically possible. Also evident was significant disdain for public views on the restart issue, and a serious lack of understanding of the legal and technical issues. This is the same agency who will ultimately decide how the water will be disposed.

We remember that between February 10-12, 1985 the Philadelphia Inquirer reported records at TMI demonstrated that in hundreds of cases, workers had been contaminated by radioactive materials either on the skin or through ingestion. The result was that workers were living in a state of anxiety, fearing cancer, birth defects and possible genetic damage for future generations.

We also remember the health suits, the spills, the fines, the leaks, the miscalibrations, the exposures, the criminal convictions and the one-celled organisms.

So when the NRC and GPU say that venting, dumping or burrying 2.1 million gallons of radioactive water will have a negligible impact on our health and environment ... people just don't believe them. Why should they? People live with in fear that they, and future generations, have suffered serious health effects as a result of the accident and GPU's mismanagement. This fear has fostered a great deal of psychological stress in our community. Stress can be translated into long term health effects, and is a very difficult to measure. Yet it is one factor the NRC will not identify in measuring health risks from the disposal of the water.

We are not scientists, and we do not feel that the burden of producing a safe, expedited method of disposal should fall on the shoulders of the community. The decision on what to do with this water should not be made in haste, and should not be made until all possible alternatives are explored and exhausted. People in this area have been dumped on enough. Were tired of being the guinea pigs.

GPU Nuclear

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4410-87-L-0050
Document ID 0165P

March 25, 1987

Michael T. Masnik
Three Mile Island Cleanup Project Directorate
Office of Nuclear Reactor Regulations
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Masnik:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Comments of Draft Supplement 2 to the
Programmatic Environmental Impact Statement - Three Mile Island Unit 2

GPU Nuclear letter 4410-87-L-0032 dated March 17, 1987, provided comments on Draft Supplement 2 to the Programmatic Environmental Impact Statement - Three Mile Island Unit 2 (PEIS). Our purpose in providing those comments was to clarify, for the record, the differences in methodologies used by the NRC and GPU Nuclear in arriving at similar off-site dose consequence conclusions as published in the PEIS and GPU Nuclear letter 4410-86-L-0114 dated July 31, 1986, respectively. Coincidentally, the comments provide a basis to respond to inquiries concerning the variations in the published dose estimates. However, it is essential that the record reflect GPU Nuclear's unqualified endorsement of the NRC conclusion that disposal of the accident-generated water can be accomplished without incurring significant environmental impact.

Sincerely,

F. R. Standerfer
Director, TMI-2

FRS/JJB/eml

cc: Director - TMI-2 Cleanup Project Directorate, Dr. W. D. Travers

This paper consisting of eight pages is submitted by me for consideration by the authorities in determining the best way to dispose of 2.1 million gallons of contaminated water at Three Mile Island-2 Nuclear power reactor.

Dr. Karl Z. Morgan

Signed and sworn before me by DR. KARL MORGAN this 23rd day of March, 1987.
My commission expires on the ____ day of ____

SIGNED:

3 23 87

A.36

Comments Relative to Treatment and Disposal of 2,100,000 gal. of Contaminated Water at TMI-2

by
Karl Z. Morgan
March 19, 1987

<u>Qualification to Express an Opinion</u>

1- So far as I can determine I am the first person to publish a paper showing how to calculate dose [illegible] internal exposure to ionizing radiation and [illegible] standards of MPC ("Tolerance Concentration of Radioactive Substances", by K.Z. Morgan, J. Phys. & Colloid Chem. 51, 984, 1947.

2- I was chairman of the Internal Dose Committees of both ICRP and NCRP for about two decades

3- I have worked with and researched ionizing radiation and health physics problems for over 50 years.

<u>Material Reviewed in Preparing these Comments.</u>

1- NUREG-0683 Sup. No. 2 (draft report)
2- GPU Nuclear Corp. Attachment 4410-87-L-0033
3- GPU Nuclear Corp. Attachment - 4410-86-L-0115
4- NCRP Commentary No. 4 "Guidelines for the Release of [illegible] from Nuclear Facilities with Special reference to the Public Health Significance of the Proposed Release of Treated Waste Waters at TMI 1987.

<u>Comments</u>

My comments are very brief because I have been able to spend only two days on this review.

<u>Comment on NCRP Comm. No 4 Report</u>

I believe that although the task group that prepared this report contained some experts in the area of radioactive waste disposal (e.g. F.L. Parker, J.W. Healy and D.G. Jacobs), the final conclusions should not be accepted in the decision to dispose of the

-2-

radioactive water by the methods proposed by GPU without some modifications. I agree with their [illegible] that after evaporation the vapor should not be released up the 50 meter stack but pumped to the 11,000 gal. [illegible] test tanks. Discharging the condensate [illegible] mixing with the 22,000 gal per minute blow-down water from the draft cooling tower is far better than direct discharge to the river but I am [illegible] to this method of disposal. I urge that rather investigation be made of disposal of the 2.1×10⁶ gal of water by one of the following methods listed in decreasing order of preference:

1- Load the water (condensed vapor) into tank cars and ship and transload on a boat for disposal at sea. This would provide a [illegible] rapid means of [illegible]. This method of sea disposal should receive no serious challenge by those concerned with our International Agreements Regarding Sea Disposal* because of the relatively low level of radioactivity and predominance of H-3. Using this method of disposal the insult to the marine environment and to man would be orders of magnitude less than those posed by the English operations near Seascale where they discharge radioactive waste into the Irish Sea. The shipment of the 490 carloads using 5000 gal tank cars should present [illegible] risks

2- Load the water (condensed vapor) in 5000 gal tank cars and send to a site prepared to dispose of the water by deep-well injection. Considering there will be very little solid material in this condensate, deep-well disposal is [illegible] to [illegible].

3- Dispose of the water (condensed vapor) by shipping in 5000 gal tank cars to a site prepared to dispose of it by the hydrofracture method.

*One of these is that of the London Dumping Convention, IMO 1985

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Comments on the NUREG-0683 Sup. No. 2 [illegible] the Two GPU Attachments

These reports as well as the NCRP report underestimate [illegible] first the discussion on the dose to the individual (rems) and the population dose (person rems). The NCRP report is doubly at fault in that it [illegible] of σ (the cancer coefficient = cancers (either incidence or mortality) = 10^{-4} cancers/person-rem which I and [illegible] others in the field believe is low at least [illegible] order of magnitude, i.e. the value should be no less than 10^{-3} cancer deaths per person rem. (See the chapter p. 216–227 [illegible] Encyclopedia Britannica, "Hazards of Low-Level Radiation" by K Z Morgan. Copy attached).

This NUREG report gives in table No. 2.5 of the NRC concentrations in air and water (above background) that are acceptable in restricted areas. Below I reproduce the first and third columns from this table but add the EPA values I calculate that are based on the EPA limit of 4 mrem/y to the total body for drinking water. Values are not given by EPA for bone so in this table I increased the value for bone from 4 mrem per year (for total body) to (30/5) x 4 = 24 mrem/y because the ICRP-2 limit for occupational exposure to bone is 30 rem/y and the limit for total body is 5 rem/y.

Isotope		Water Activity Limit of NRC (µCi/cc)	Water Activity Limit of EPA (µCi/cc)
H-3	S-TB	3x10^{-3}	2.4x10^{-5}
	I	3x10^{-3}	—
	Sub	—	—
Cs-137	S-TB	2x10^{-5}	1.6x10^{-7}
	I	4x10^{-5}	—
Sr-90	S-B	3x10^{-7}	3.2x10^{-9}
	I	4x10^{-5}	—

S-Soluble, I-Insoluble, TB-Total Body, B-Bone

Here it is noted there is essential agreement for H-3 but the NRC value is 125 times the EPA value for Cs-137 and 12,500 times the equivalent value for Sr-90.

When two Government agencies differ to such [illegible] in evaluating an [illegible] risk, I believe the agencies [illegible] in the [illegible] of safety should insist the more conservative agency [illegible] and the one in this case established to protect man and his environment take precedence.

[illegible] a quick look at Tables 2.2 and 2.3 in NUREG-0683 Sup. No. 2 and the tables in the [illegible] GPU Attachment [illegible]. The data in these tables were [illegible] confusing. Below in columns 2 & 3 (1st two items) I give data from these tables. Where the values in these [illegible] differ, I enter in column 3 the [illegible] that was presented last. I assume [illegible]

Radionuclide, (Fw) (Effective Half Life)	Base Case	Achievable Values
H-3 (t = 12 [illegible])		
Activity (µCi/cc)	0.13	0.13
Dose Estimates (mrem):		
NUREG-0683-2	7.8 (a) TB	7.8 [illegible] TB
One year dose from continuous exposure	10,6[illegible] TB	
70 year dose from continuous exposure	7.7x10^{5} TB	
Dose from 1 day's intake of 1000 cc water	.14 TB	
Dose from 1 day's intake of 2200 cc water	.30 TB	
Cs-137 (t = 1 [illegible] 70 days in total body)		
Activity (µCi/cc)	3.7x10^{-5}	4.0x10^{-6}
Dose Estimates (mrem):		
NUREG-0683-2	(a) 6.6 TB, 3.6 B	0.29 TB, 0.32 B
One year dose from continuous exposure	947 TB	
70 year dose from continuous exposure	90,300 TB	
Dose from 1 day's intake of 1000 cc water	(b) 1.6 TB	
Dose from 1 day's intake of 2200 cc water	3.6 TB	
Sr-90 (t = [illegible] 17.53 years in bone)		
Activity (µCi/cc)	1.1x10^{-4}	1.0x10^{-5}
Dose Estimates (mrem):		
NUREG-0683-2	(a) 960 B, 19 TB	87 B, 1.2 TB
One year dose from continuous exposure	57,600 B	
70 year dose from continuous exposure	137,000,000 B	
Dose from 1 day's intake of 1000 cc water	(b) 3,690 B	
Dose from 1 day's intake of 2200 cc water	8,690 B	

Ru-106 ($t_{1/2}$=0.99y) (2 days in Kidney)	
Activity (μCi/cc)	$< 3.1 \times 10^{-6}$
Dose estimates (mrem):	
NUREG-0683-2	—
One year dose from continuous exposure	< 12, K
70 year dose from continuous exposure	< 830, K
Dose from 1 day intake of 1000 cc of water	< 0.015, K
Dose from 1 day intake of 2200 cc of water	< 0.032, K
Dose to GIT(LLI) from 1y continuous exposure	< 47, GIT
Co-144 ($t_{1/2}$=0.78y) (6 days in Bone)	
Activity (μCi/cc)	$< 1.8 \times 10^{-6}$
Dose estimates (mrem):	
NUREG-0683-2	—
One year dose from continuous exposure	< 2.7 B
70 year dose from continuous exposure	< 532 B
Dose from 1 day intake of 1000 cc of water	< 0.010, B
Dose from 1 day intake of 2200 cc of water	< 0.021, B
Dose to GIT(LLI) from 1y continuous exposure	< 27, GIT
Co-60 ($t_{1/2}$=5.3y) (9.5 days in Total Body)	
Activity (μCi/cc) GPU	4.8×10^{-7} TB
Dose estimates (mrem)	
NUREG-0683-2	—
One year dose from continuous exposure	1.67, TB
70 year dose from continuous exposure	122, TB
Dose from 1 day intake of 1000 cc of water	0.002, TB
Dose from 1 day intake of 2200 cc of water	0.005, TB
Dose to GIT(LLI) from 1y continuous exposure	1.44 GIT
Pu-239 ($t_{1/2}$=2.4×10^{4}y) (12,000 days in Bone)	
Activity (μCi/cc) GPU	$< 14 \times 10^{-9}$ E
Dose estimates (mrem)	
NUREG-0683-5	—
One year dose from continuous exposure	< 0.24, B
70 year dose from continuous exposure	< 1098, B
Dose from 1 day intake of 1000 cc of water	< 0.17 B
Dose from 1 day intake of 2200 cc of water	< 0.38. B
Dose to GIT(LLI) from 1y continuous exposure	< 0.07, GIT

TB - Total Body
B - Bone
K - Kidney
GIT(LLI) - Gastro-intestinal tract (Lower large intestine)

and made a number of calculations (from a variety of sources I calculated and entered some of the results in the above table. All the values are for the adult (standard reference man). The doses in NUREG-0683 have been considerably larger than those I calculated but I have not had time to make these calculations. The dose values marked (a) given in NUREG-0683 check with my calculated values of those marked (c) but I will be noted two of my values, 14 mrem for H-3 and 3,680 mrem for Sr-90 are slightly less than the NUREG values that are 17.8 mrem for H-3 and 960 mrem for Sr-90 while my value of 1.6 mrem for Cs-137 is lower than the NUREG value of 19.6 mrem. These differences should be investigated. These values are for an intake of 1000 cc of the processed water. I don't know why the NRC staff used only one intake of 1000 cc. The standard man consumes 2200 cc per day so I made these calculations obtaining 30 mrem for H-3 and 3.6 mrem total body from Cs-137. Note that these values of one days intake should be compared with the EPA limit of 4 mrem for drinking water. The equivalent EPA values for bone and kidney are $(30/5) \times 4 = 24$ mrem and $(15/5) \times 4 = 12$ mrem where 30 rem/y, 5 rem/y and 15 rem/y are the limiting dose rates for bone, total body and kidney respectively for the occupational worker.

I noticed of the three radionuclides, Sr-90 Co-144 and Pu-239 for which bone is often the critical body organ. Here it is noted the values for Sr-90 (3680 mrem from 1 days intake of 1000 cc or 8,096 mrem for 1 days intake of 2200 cc far exceed the EPA equivalent limit of 24 mrem per year, and most of this dose is in the first year after intake. The GPU provides no data for activities of Ru-106, Co-144 or Pu-239 but their limit of detection is adequate for a single intake of 1000 cc or 2200 cc (i.e. 0.015 mrem and 0.032 mrem are < 12 mrem and 0.01 mrem, 0.021 mrem, 0.1 mrem and 0.38 mrem are less than the 24 mrem/y bone dose limit).

It seems to me that an evaluation of the dose from one days intake of 1000 cc or 2200 cc of processed water

does not strike at the more meaningful [illegible] of C[illegible] intake of the processed water. For continuous intake for one year the dose are 10,000 mrem for H-3, 947 mrem for Cs-137, 57,600 mrem for Sr-90, < 12 mrem for Ru-106, < 2.7 mrem for Ce-144, < 1.67 mrem for Co-60 and < 0.24 mrem for Pu-239. Were a standard man to consume this water for 70 years at the proposed level of contamination at discharge, the dose would be 770,000 mrem for H-3, 90,300 mrem for Cs-137, 139,000,000 mrem for Sr-90, < 830 mrem for Ru-106, < 532 mrem for Ce-144, 122 mrem for Co-60 and < 1098 mrem for Pu-239. Hence it is seen that levels below the limit of GPU detection would be for intakes of a safe dose for long option of the water for 70 years.

Finally I looked at the dose to the GIT from one years Consumption of Ru-106, Ce-144, Co-60 and Pu-236. The values respectively are < 47 mrem, < 27 mrem, 1.14 mrem and < 0.07 mrem. Thus in all three cases the GIT is not the organ of highest dose

In Conclusion

I believe that the studies made by GPU and by the NRC staff are woefully inadequate and much more data should be provided before deciding the best way to be rid of this problem, i.e. before deciding to let go of the bear we have by the tail.

Karl Z. Morgan

Dose Rate

$\dot{R}(\text{mrem/y}) = q(\mu\text{Ci})\, 3.7\times10^{4}(\text{dis/s}/\mu\text{Ci})\, \text{EQN}\,(\text{MeV/dis})\times 1.602\times10^{-6}(\text{erg/MeV})\times(1/\text{g})\times10^{3}(\text{mrem/rem})\times 3600\times24\times365.5(\text{s/y})\times(1/100)(\text{rad/g}) = \frac{1.87\times10^{7}\,\text{EQN}\,q}{m}$ mrem/y (1)

Dose from a Single Intake

$D = \int_0^{\infty} \dot{R}e^{-\lambda t}dt = \frac{\dot{R}}{\lambda}(1-e^{-\lambda t}) = \frac{1.87\times10^{7}\,\text{EQN}\,q}{m\lambda}(1-e^{-\lambda t})$ mrem (2)

Dose from Continuous Intake

$\frac{dq}{dt} + \lambda q = P$

$q = \frac{P}{\lambda}(1-e^{-\lambda t})$

$P = i(\text{cc/y})\, f_w\, C(\mu\text{Ci/cc}) = 2200(\text{cc/d})\,365(\text{d/y})\, f_w C = 8.03\times10^{5} f_w C$

$D = \int_0^{t} \frac{1.87\times10^{7}\,\text{EQN}\times 8.03\times10^{5} f_w C}{m\lambda}(1-e^{-\lambda t})dt =$

$D = \frac{1.50\times10^{13}\,\text{EQN}\, f_w C}{m\lambda}\left(t + \frac{e^{-\lambda t}}{\lambda} - \frac{1}{\lambda}\right)$ mrem (3)

Dose from One Day's Intake after Exposure of t years

$q_1 = 2200 f_w C$

$D = \int_0^{t} \frac{1.87\times10^{7}\,\text{EQN}\, 2200 f_w C\, e^{-\lambda t}dt}{m}$

$D = \frac{4.11\times10^{10}\,\text{EQN}\, f_w C(1-e^{-\lambda t})}{m\lambda}$ mrem (4)

$D = \frac{4.11\times10^{10}\,\text{EQN}\, f_w C}{m\lambda}$ mrem for $t \to \infty$ (4)'

Dose to Lower G.I. Tract (Colon) from One Year Continuous Exposure at ICRP-2 MPC Level

$(\text{MPC})_{\text{LLI}}^{\text{GRAD}}$ corresponds to $\dot{R} = 15000$ mrem/y dose rate when exposure time, t_1, is $\gg$ 18 hours.

$D_1 = \frac{C\times1500}{(\text{MPC})_{\text{LLI}}^{\text{GRAD}}}$ mrem (5)

GPU Nuclear

GPU Nuclear Corporation
Post Office Box 480
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Middletown, Pennsylvania 17057
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TELEX 84-2386
Writer's Direct Dial Number:

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4410-87-L-0018
Document ID 0068P

February 3, 1987

FRS/JJB/eml

Attachment

cc: Regional Administrator - Region 1, Dr. T. E. Murley
Director - TMI-2 Cleanup Project Directorate, Dr. W. D. Travers

Document Control Desk
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Disposal of Processed Water

Attached for your information are results of analyses performed for GPU Nuclear by the Westinghouse Advanced Energy Systems Division Analytical Laboratories. These analyses were performed as part of the waste stream classification requirements of 10 CFR Part 61. They provide additional information regarding the radionuclide content of selected processed water streams at TMI-2. This data was not available prior to publication of Draft Supplement 2 to the Programmatic Environmental Impact Statement - Three Mile Island Unit 2 (PEIS).

The data provided in the attachment is representative of the radionuclide inventory of TMI-2 water which has undergone processing. In accordance with our July 1986 proposal for the disposal of TMI-2 water by the evaporation process, this water would not be reprocessed prior to evaporation. Therefore, these data are representative of the influent stream to the evaporation system and are provided for your consideration in that context. Similar data is not reported by Westinghouse for tritium (H-3) since an analysis for tritium was not performed. The data reported in our July 1986 proposal for the "Disposal of TMI-2 Water" remains valid.

Sincerely,

/s/ R. E. Rogan for

F. R. Standerfer
Director, TMI-2

ATTACHMENT
4410-87-L-0018

MESTINGHOUSE ADVANCED ENERGY SYSTEMS DIVISION ANALYSES

	CCT-1 85-10962 09/18/85 86-2007		CCT-2 85-11240 09/26/85 86-2008		PWST-1 85-15995 12/20/85 86-2009		PWST-2 85-16198 12/23/85 86-2010	
	uCi/ml	2S	uCi/ml	2S	uCi/ml	2S	uCi/ml	2S
Co-60	1.2E-7	8.4E-8	< 4.5E-8		< 1.0E-7		1.8E-7	5.2E-8
Ag-110m	< 3.6E-7		< 1.2E-7		< 2.3E-7		< 1.1E-7	
Sb-125	< 3.3E-7		< 1.1E-7		< 2.7E-7		3.4E-7	1.1E-7
Ru-106	< 1.1E-6		< 5.3E-7		< 9.8E-7		< 5.2E-7	
Cs-134	3.2E-7	1.2E-7	1.2E-7	4.5E-8	2.4E-7	8.1E-8	2.1E-7	4.4E-8
Cs-137	6.5E-6	2.5E-7	2.6E-6	7.6E-8	6.4E-6	2.2E-7	4.8E-6	9.9E-8
Ce-144	< 7.8E-7		< 3.0E-7		< 5.7E-7		< 2.8E-7	
Sr-90	9.0E-6	1.8E-7	1.8E-7	3.6E-8	7.9E-6	1.8E-7	2.1E-5	2.9E-7
I-129	< 4.8E-7		< 5.3E-7		< 6.2E-7		< 5.9E-7	
Ni-63	< 5.4E-7		< 5.2E-7		8.4E-7	6.5E-7	< 5.6E-7	
Tc-99	< 2.6E-7		< 2.7E-7		9.9E-7	3.2E-7	< 2.5E-7	
C-14	1.4E-4	9.8E-6	1.1E-4	1.1E-5	5.1E-5	6.2E-6	3.0E-4	1.1E-5
U-234	< 1.1E-8		< 1.4E-8		< 1.6E-8		< 1.5E-8	
U-235	< 6.2E-9		< 6.9E-9		< 1.2E-8		< 8.7E-9	
U-238	< 8.4E-9		< 8.1E-9		< 1.2E-8		< 1.4E-8	
Pu-238	< 1.1E-7		< 1.2E-8		< 1.2E-8		< 1.1E-8	
Pu-239/240	< 3.7E-8		< 1.3E-8		< 1.4E-8		< 1.2E-8	
Am-241	< 4.6E-8		< 1.2E-8		< 1.2E-8		< 1.1E-8	
Cm-242	< 1.1E-7		< 8.6E-8		< 6.3E-8		< 6.1E-8	
Cm-243/244	< 2.0E-8		< 1.0E-8		< 1.1E-8		< 8.6E-9	

GPU Nuclear

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4000-87-S-059
Document ID 0023P

February 20, 1987

Mr. Arthur E. Morris
Chairman, The Advisory Panel for the Decontamination
of Three Mile Island Unit 2
P.O. Box 1559
Lancaster, PA 17603

Dear Chairman Morris:

Subject: Disposal of Processed Water

Attached for your information is a copy of a letter we have sent to the NRC providing additional information with respect to the radiochemistry of the TMI-2 Processed Water. We will be prepared to discuss this information with you in detail at the upcoming Advisory Panel Meeting on February 26, 1987.

Sincerely,

F. R. Standerfer
Director, TMI-2

FRS/eml

Attachment

cc: Advisory Panel Members

GPU Nuclear

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4410-87-L-0023
Document ID 0068P

February 18, 1987

US Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Disposal of Processed Water

The purpose of this letter is to provide you the results of GPU Nuclear's recent assessment of radionuclides which may be present in the processed water at TMI-2.

As discussed in GPU Nuclear letter 4410-86-L-0114 dated July 31, 1986, which requested NRC approval for disposal of processed water at TMI-2, certain radionuclides will be present in the evaporator effluent. Specifically, that submittal evaluated the population and environmental effects of tritium (H-3), strontium-90, and cesium-137.

GPU Nuclear letter 4410-87-L-0018 dated February 3, 1987, forwarded the results of analyses performed for GPU Nuclear by the Westinghouse Advanced Energy Systems Division Analytical Laboratories. That submittal provided additional information regarding the radionuclide content of selected processed water streams at TMI-2. Because these analyses provided information that was not previously available, GPU Nuclear undertook a comprehensive review of the radionuclides potentially present in the processed water and, based on the disposal scenario described in the July 31, 1986 submittal, may be a constituent of the evaporator influent.

As part of this review, GPU Nuclear developed a list of particulate radionuclides (see attachment) based on the following criteria:

1. Radionuclides specifically identified in 10 CFR Part 61.
2. Greater than 0.1% of the core isotopic content, on a curie basis, eight (8) years following the TMI-2 Accident as determined by the ORIGEN computer code.
3. Greater than 0.1% of the core transuranic inventory, on a curie basis.
4. Reactor Coolant System activation products of practical interest as identified by the Babcock and Wilcox Water Chemistry manual.

Additionally, the attachment provides an assumed average concentration of each radionuclide potentially present in the evaporator influent (i.e., total curie content of the radionuclides in the various water sources divided by the total volume of processed water). In developing this list, GPU Nuclear used lower limits of detection (LLD) or the actual measured activities for the radionuclides listed. The activity of radionuclides for which no data were available were estimated by various means. For example, the europium, samarium, and promethium values were based on a ratio between the core isotopic ratios given by ORIGEN and the known LLD of Ce-144. This provides a maximum activity which could be present in the presence of no greater than LLD activity of Ce-144. This is a reasonable approach since these elements are all rare earths and are chemically similar. It should be noted that the concentrations listed on the table are average concentrations. Actual concentrations in specific water sources may vary from that listed.

Using the radionuclide concentrations listed, GPU Nuclear conducted a comparative evaluation of the potential off-site effects of these radionuclides, relative to Sr-90, based on the total dose commitment resulting from the ingestion pathway or summation of all pathways as available in the references. The dose due to exposure to the plume was not considered for this analysis since its contribution to an individual's total dose is several orders of magnitude less than the ingestion pathway. As noted in Section 8.1 of our July 31, 1986, submittal, Sr-90 was used as the basis for the relative assessment since it is the most radiologically significant radionuclide.

Based on the above assessment, the potential impact of each radionuclide was derived by multiplying the known or calculated activity or the LLD listed on the attachment by pathway dose conversion factors from the TMI-2 Off-site Dose Calculation Manual or the Total Dose Commitment values from EPRI NP 3840 to obtain an indication of the relative impact of the isotope (see Attachment). Based on this review, three (3) additional isotopes were identified for which the off-site dose contribution exceeds 1% of the off-site dose from Sr-90. These isotopes are C-14, Tc-99, and I-129. However, values listed can only be considered an indication of the order of magnitude of the relative impact. The difference in critical organ for the various radionuclides makes direct addition of the ratios incorrect. For example, although I-129 is estimated to

have an approximate impact of 19% when compared to Sr-90, it does not indicate that the dose to the individual would increase by 19%; the critical organ dose calculated for Sr-90 is applied to the bone whereas the dose from I-129 would be to the thyroid.

With the exception of the special case of I-129, as noted above, this analysis also reaffirms that the LLD's established for the various radionuclides listed herein are sufficiently low to ensure that the environmental impact at those concentrations would be insignificant (i.e., less than 1% of the relative contribution from Sr-90).

Considering the potential contribution of these three additional radionuclides to off-site dose resulting from disposal of the TMI-2 processed water by evaporation, GPU Nuclear has concluded that the off-site environmental consequences remain well below regulatory limits (i.e., 10 CFR 50, Appendix I) and the potential impact to the population and the environment remains insignificant. We are confident that your analysis of these data, in support of finalization of the PEIS, will support this conclusion.

Sincerely,

/s/ F. R. Standerfer

F. R. Standerfer
Director, TMI-2

FRS/JJB/eml

cc: Regional Administrator - Region 1, Dr. T. E. Murley
Director - TMI-2 Cleanup Project Directorate, Dr. W. D. Travers

AVERAGE CONCENTRATION OF RADIONUCLIDES
POTENTIALLY PRESENT IN TMI-2 WATER FOR EVAPORATION

Radionuclides	Concentration (uCi/ml)	Relative Off-site Dose Impact Compared to Sr-90
H-3	1.3 E-1	<0.01 [2]
C-14	1.0 E-4	0.50 [3]
Mn-54	<4.0 E-8	<0.01
Fe-55	4.8 E-7 [1]	<0.01
Co-58	<4.0 E-8	<0.01
Co-60	4.8 E-7	<0.01
Ni-63	<6.0 E-7	<0.01
Zn-65	<9.8 E-8	<0.01
Sr-90/Y-90	1.1 E-4	1.00
Tc-99	1.0 E-6	0.20
Ru-106/Rh-106	<3.3 E-7	<0.01
Ag-110M	<5.6 E-8	<0.01
Sb-125/Te-125m	2.3 E-6	<0.01
I-129	<6.0 E-7	0.19[4]
Cs-134	8.8 E-7	<0.01
Cs-137/Ba-137m	3.6 E-5	<0.01
Ce-144/Pr-144	<2.1 E-7	<0.01
Pm-147	<4.8 E-6 [1]	<0.01
Sm-151	<1.1 E-7 [1]	<0.01
Eu-152	<3.8 E-10 [1]	<0.01
Eu-154	<4.4 E-8 [1]	<0.01
Eu-155	<1.1 E-7 [1]	<0.01
U-234	<1.0 E-8	<0.01
U-235	<1.2 E-8	<0.01
U-238	<1.2 E-8	<0.01
Pu-238	<1.2 E-8	<0.01
Pu-239	<1.4 E-8	<0.01
Pu-240	<1.4 E-8	<0.01
Pu-241	<6.5 E-7 [1]	<0.01
Am-241	<1.2 E-8	<0.01
Cm-242	<1.0 E-7	<0.01

1 Calculated concentration

2 H-3 ratio is based on food pathway. Since tritium is present in a gaseous form, it also has a inhalation pathway constituent. As total H-3 impact was evaluated in the July 31, 1986 submittal, it was not further evaluated here.

3 Ratio listed is for C-14 if present in a carbonate or organic form. If C-14 is present as a dissolved gas (e.g., CO_2), the ratio would be <0.01.

4 The relative off-site dose impact compared to Sr-90 listed for I-129 assumes it is present at LLD (i.e., 6.0 E-7); therefore, 0.19 is a maximum value. The actual relative off-site dose impact for I-129 would be less than this value.

5 < means less than.

Susquehanna Valley Alliance
P.O. Box 1012 · Lancaster, PA 17604
(717) 394-2782

Dear Dr Masnik,
At their request, please accept the comments made by Dr Ernest Sternglass and Dr Richard Piccioni to the Citizens' Advisory Panel in Harrisburg on March 25th. 1987, as an official part of their comments on the NRC's supplement to their Environmental Impact Statement.

Thank you,
Frances Skolnick

Frances Skolnick
Coordinator, SVA.

Susquehanna Valley Alliance
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The Susquehanna Valley Alliance is a safe energy organisation whose membership mostly resides in Lancaster County, Pa. The organisation was formed as a direct result of the accident at Three Mile Island and the threat that the radioactive water from the accident would be dumped into the Susquehanna River, drinking water source for many citizens of Lancaster County.
Below are the comments of this organisation on the NRC's supplement to their Environmental Impact Statement.

We have read the comments of Dr Michio Kaku, Dr Karl Morgan, and Dr Carl Johnston. We accept their findings that this document is inadequate, shows major inaccuracies and displays a lack of scientific skill in its preparation. In light of this, we are unable to accept the NRC's findings that any method of disposal of this water will have little impact on our environment.

We understand that this document is a draft, however this is no excuse for the NRC to have omitted from the table of contents of this water, a list of all radionuclides, including transuranics. It was not until the SVA requested the list that the NRC mentioned these elements. This appears to be an attempt to misdirect the accurate attempts to analyse this document, and to fully determine the impact that any disposable method might have on the environment. This water covers the melted fuel and is therefore highly suspected of containing alpha radiation. Some transuranics, for example, plutonium, are highly toxic to man and have a long life. Plutonium is soluble in water and was found in the water in Denver which is downwind of Rocky Flats. So even though these elements may not be so abundant as strontium, cesium and tritium, it is essential that due to their toxicity to man, alpha sensitive radiation monitoring equipment is used to analyse the water now. Only then can an accurate assessment of the environmental impact of any disposal method be made.

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Aside from the possible transuranic content of this water, cesium, strontium and tritium will be released into our environment. These releases will be in addition to those releases imposed upon this population by the releases of the accident, the Krypton venting, the clean-up, and operations at Unit 1. These releases from any disposal method cannot be considered in isolation from all future releases from nuclear power plants, and indeed as we have seen from the events at Chernobyl, it is not only releases from local power plants that impact upon the population, but also releases from any plant anywhere.

Tritium is of special concern since there is no scientific proof that it is not harmful to the human organism. It is easily taken into the body by inhalation or ingestion. Indeed experiments have shown that laboratory animals have suffered cancer, birth defects and genetic mutations from exposure to tritium. It is extremely imprudent to disperse radioactive materials into our environment without having a full understanding of their effects on the human organism.

In the EIS(1981) the NRC discussed the problem that the chemicals used in the decontamination solutions and the oils and greases in the reactor vesselcould clogg the Epicor and SDS systems and cause them to work ineffectively especially towards the end of the clean-up after the fuel has been removed. This then would present a new problem in that the water may have a different content prior to going into the evaporator. This problem was neglected in the supplement.

Since the evaporation method is the preferred method of disposal by GPU Nuclear it would have been more appropriate for the NRC to give a more thorough understanding and evaluation of the system. It is unclear how long it takes for the system to close down when particulate matter begins to escape into the environment, and how much will escape before the system is completely closed off to the environment.

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Furthermore, how many workers will work solely at the evaporator system and tend to it while in operation. Also, we are not informed as to the optimum temperatures needed to boil the water and prevent the particulate matter from going into the stack and hence into the environment. We have no trust whatsoever in GPU Nuclear's ability to run the system with only the public's health and safety in mind.

Th is document mis-uses the words "small", minimum" and "fraction" when referring to radioactive materials and their effect. The words are meaningless to us and scientists around the world who can show with scientific proof that there is no safe level of radiation for the human organism. Therefore the problem is not with what the evaporator system can hold within the system but with the "small amounts" of radioactivity which will escape into the air which we breathe. We learn that "the fraction released would be dependent upon the concentration in the water input; the feed rate to the evaporator; the design of the evaporator; and the removal fraction from plate-out on the moisture seperator, ducts and stack" This turns out to be an abundance of variables affecting the possible release of radionuclides into our environment. In spite of this we are not informed by the NRC how these variables will be controlled or how they derived their conclusion that they "concur with this achievable level" It is obvious to us that GPU Nuclear is being given too much liberty in controlling this situation. This is outrageous in view of the leak rate falsification activities prior to the accident in 1979.

The NRC should have clearly stated in their document why there is an initial concentration of radionuclides in the accident generated water. Does this mean that we can expect a concentration of radionuclides each time the evaporator has been shut off for one reason and another and then started up again. Furthermore, the NRC neglected to make an analysis of the impact in the event of a malfunctioning of the evaporator system.

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We cannot accept the dispersal of radioactivity into our environment in light of the fact that there are other options available to contain this radioactivity. It is total insanity to sit and talk about boiling up water and allowing the radioactive waste free access to our bodies. This population has suffered sufficient damage at the hands of GPU Nuclear. There should be no further onslaught of radiation on their immune systems.

Frances Skolnick

Frances Skolnick
Coordinator SVA.

A.47

TMIA: THREE MILE ISLAND ALERT, INC.
315 Peffer St., Harrisburg, Penna. 17102 (717) 233-7897

April 11, 1987

Dr. Michael T. Masnik
TMI Cleanup Project Directorate
Division of PWR Licensing-B
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Dr. Masnik:

Three Mile Island Alert (TMIA) is a non-profit, safe energy organization formed by citizens in the community, following the construction and licensing of the Three Mile Island (TMI) nuclear power plant in 1977. We have represented community concerns in Nuclear Regulatory Commission (NRC) hearings on a broad spectrum of issues dealing with the licensing and operation of TMI Unit 1. As a public interest group dedicated to maintaining the integrity of the environment and to protecting public health and safety, we are opposed to any additional releases of radiation from the operation of Unit 1 or the cleanup of Unit 2.

TMIA has reviewed the NRC's draft supplement to the Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident Three Mile Island Nuclear Station, Unit 2 (NUREG-0683) and conferred with noted experts in the field of nuclear physics, radiation and health. This document is deficient in many areas and demonstrates the NRC's disregard for its mandate to protect the health and safety of the public.

TMIA rejects the revised EIS as irresponsible and unacceptable for many reasons.

- "Disposal" is actually an incorrect and misleading term. There will be no actual disposal of the radioactive water. Methods being considered are those that involve dispersal to, and contamination of, the environment.

- The EIS has listed an incomplete inventory of radionuclides actually found in the contaminated water. For example, the list of radionuclides on page 2.3, Table 2.2 of the revised EIS omits many important radionuclides originally listed in the first EIS, pages 7-5,7-6,7-7.

- Neither the revised EIS or the original have a complete accounting of the transuranics in the water.

- The current EIS lists only 1,020 curies of tritium in the waste water, when the original count was 2,500 curies.

- Serious consideration was not given to the potentially hazardous health effects if tritium is incorporated into the body. It will become a long-term part of the body's chemistry, irradiating body tissues for the life-span of the individual. Current studies indicate that there will soon be conclusive evidence demonstrating that tritium is much more hazardous than previously thought.

- The release of tritiated water into the atmosphere by evaporation will cause the HTO to become part of our environment. It will enter into the food chain, and essentially become part and parcel of every living organism.

- Any method which involves additional radioactive contamination of the environment and radiation exposure to citizens, is unacceptable. The EIS neglects the fact that the population has been exposed for years, to radioactive emissions from TMI. Studies have documented the hazards associated with cumulative doses of low-level radiation, especially the increased chances of developing cancer.

- The EIS does not contain a meteorological study. Considering that evaporation seems to be the preferred method of the utility, wind patterns need to be studied. Controlled evaporation methods should assure that certain segments of the population do not receive concentrated doses due to weather patterns and prevailing winds.

- The EIS does not address the impact of psychological stress on citizens living in the surrounding communities.

- Potential economic loss on the part of citizens whose businesses may be affected by the method of disposal, has not been evaluated. For example, the Central Pennsylvania area is a major eastern tourist center (Hershey, Pennsylvania Amish, etc.). Many businesses may be hurt if people decide not to bring their families to a vacation spot where they will be exposed to radioactive emissions. The sale of agricultural products will be affected, since consumers may be wary of radioactive contamination. If river dumping is allowed, there is the potential for adverse effects on the seafood industry of the Chesapeake Bay.

The revised EIS is a shockingly incomplete, inadequate, insubstantial and misleading document.

The NRC has not mentioned in the EIS or in any other document, any intent to closely monitor methods used by the utility and its vendors. This is a utility that has in its history, a record of deception, falsification and destruction of documents, employee harassment, equipment malfunction, and other examples that demonstrate a lack of integrity.

TMIA urges the Commission to disapprove NUREG-0683, the EIS Supplement, and to order a complete and reliable scientific study of environmental impacts. In addition, we request that until a method of dealing with the radioactive waste water is found, that involves no environmental release, the water be contained on site, in continuous monitored storage.

Sincerely,

Vera L. Stuchinski

Vera L. Stuchinski
Chairperson
Three Mile Island Alert
315 Peffer Street
Harrisburg, PA 17102

cc: Commissioner Zech
Commissioner Roberts
Commissioner Asselstine
Commissioner Carr
Commissioner Bernthal

Nuclear

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4410-87-L-0056
Document ID 0165P

April 14, 1987

Michael T. Masnik
Three Mile Island Cleanup Project Directorate
Office of Nuclear Reactor Regulations
US Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Masnik:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Comments on Draft Supplement 2 to the
Programmatic Environmental Impact Statement - Three Mile Island Unit 2

The purpose of this letter is to provide additional information, not previously available, for your consideration in development of the Final Supplement 2 to the Programmatic Environmental Impact Statement - Three Mile Island Unit 2 (PEIS). It also responds to previously expressed concerns relative to the potential for release of particulates to the atmosphere during the proposed evaporation process.

GPU Nuclear has received process-specific data concerning the potential for particulate releases during the evaporation process. These data are based on information recently received from the several vendors proposing systems for use at TMI-2. The information indicates that the potential for particulate release, due to the sodium and boron concentrations present in the processed water, ranges from essentially no release to a maximum of 5.3×10^{-6} pounds (3.7×10^{-4} grains) of particulate per dry standard cubic foot of evaporator

stack effluent. This is much less than the conservatively estimated 1% maximum particulate carryover previously discussed in the GPU Nuclear environmental statement.

Sincerely,

F. R. Standerfer
Director, TMI-2

FRS/JJB/eml

cc: Director, TMI-2 Cleanup Project Directorate - Dr. W. D. Travers

Comments on the Draft Supplement to the
Programmatic Environmental Impact Statement
Regarding Disposal of Accident-Generated Water From
Three Mile Island Unit 2

NUREG-0683 Supplement No. 2 says it explores the decontamination and disposal of radioactive waste (water) from the March 28, 1979 accident at TMI. It purports to exhaust the subject, when actually it has overlooked many of the most important considerations.

It does not discuss decontamination other than to say it expects all the accident-generated water to be reprocessed by the SDS and Epicor II systems. The public does not believe that this will decontaminate the water of all transuranics and all but seven elements. I cannot believe that the water has washed the degraded fuel and has shielded the radioactive sludge for years without being loaded with many other dangerous elements which didn't wash out of the system.

I am not sure that the chemicals in the mix are not radioactive. In the 1981 EIS it was stated that "fines" could delay the cleanup. "Fines" were defined as minute particles with a radioactive burden which could not be filtered out of the water. Could some of these particles be chemicals?

There is no assurance that the micro-organisms that grow wildly in the radioactive hot water will be killed before the water is dispersed. Can we be sure that they would not create a health hazard?

While the alternatives have been presented at length, the environmental impacts in the TMI area have been dismissed in many cases with a sentence or two.

For instance, the option to dump the water in the Susquehanna says little about the number of dams downstream which collect silt and could intensify the build-up of any contaminants. It dismisses the impact on the fish which support an enormous industry in the Chesapeake Bay. A privately funded study of the impact of TMI on the Susquehanna by the TMI Health Fund has apparently not been consulted. It would have been a good idea to find out what radioactivity has already done to this river. This could also have included the effects of the Susquehanna and Peach Bottom nuclear plants.

The TMI area lies in a river basin surrounded by hills which trap the air. It is subject to fog and to inversions. This meteorology, coupled with a relatively high density of population has led to restrictions on burning of trash in the area. Yet, there is not one mention of these factors in the EIS.

The draft does not discuss the fact that the prevailing winds carry radioactive water toward one group of people more often than not. The population on the hillside, on an elevation even with the top of the stacks, downwind, already feels it has suffered severe health effects fromthe accident and clean-up. Air dispersal would impact these people more than others.

Important to all of us is the fact that any dispersal of this radioactive water is just that much more radioactivity, when we have already had enough. No-one has given us an accounting of how much radioactivity we got from the accident, from venting, and from cleanup, not to mention the operation of Unit 1 before and after the accident. This EIS does not do that either.

The draft talks about inconsequential effects of radiation on the one hand and fatalities from cancer or traffic accidents on the other. Where is the discussion of cancer incidence, genetic effects, or increased susceptibility to chronic diseases?

Except for the effects of drinking the water, little is said about the disproportionate effect of radiation on the fetus or the developing child.

Most importantly, none of the alternatives presented actually disposes of the radioactive water. Real disposal would effectively isolate the radioactivity from the biosphere. All the alternatives in this draft except for the No-Action alternative effectively disperse the radioactivity rather than isolate it.

This is truly ironic because apparently the main reason the NRC has presented an EIS is to satisfy the TMI public which objects to any more radioactivity being dispersed into its environment.

Why is the alternative presented in this draft which seems to do all the right things for the public rejected?

The No-Action Alternative of Liquid Storage in Tanks On-Site:

1. Does not pollute the downstream water supplies
2. Does not force the public to breathe radioactive vapor
3. Could cost as little as zero dollars
4. Would not create additional occupational exposure
5. Would have no significant exposure pathways to the public other than from accidents (which the draft minimizes)
6. Would require no additional land commitment
7. Would take no transportation risks.

How can the NRC say "no?" The only explanation given is that the NRC feels it merely defers disposal. The people around TMI do not want to see this alternative dismissed with a word like "merely."

1. It would allow most of the stated radionuclides to have passed through 10 half-lives, to have practically disappeared by disintegration.

2. It would allow Strontium-90 (28.5 years) and Cesium-137 (30.2 years) to have disintegrated through one full half-life.

3. It would allow a whole generation which has experienced the accident, the venting and the cleanup to age without more irradiation.

Only two reasons are given by the NRC for not considering this option.

1. The NRC has made a policy decision not to make TMI a nuclear waste dump. The public applauds this decision. Unfortunately it is not entirely honest because no-one plans to dismantle and carry off the present plants nor to abolish the pool of used fuel rods. So why would the NRC worry about a little radioactive water which they do not consider dangerous?

2. It creates an administrative problem for the NRC by putting off a "final" decision, perhaps beyond the date of the license expiration.

I believe that the NRC simply wants to make the water "disappear" so that 30 years from now the public will not be reminded that the accident happened and it didn't go away.

Whatever scientific evidence is presented in this draft I believe is essentially irrelevant. What we are commenting on is public policy.

Deliberately dumping nuclear wastes on the public in any quantity is bad public policy in a democracy. Dumping them on a public which has already been traumatized and had its health endangered by a nuclear accident is completely unacceptable.

I urge the NRC to reconsider - to contain the water, not disperse it- at TMI or anywhere else.

- Beverley Davis
200 Gettysburg Pike
Mechanicsburg, PA 17055

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
EXTERNAL AFFAIRS

MAR 24 [redacted]

Dr. Michael T. Masnik
TMI Project Directorate
Office of Nuclear Reactor
Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Masnik:

In accordance with Section 309 of the Clean Air Act and our responsibilities under the National Environmental Policy Act, the U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Nuclear Regulatory Commission's (NRC) Draft Supplement No. 2 to the Programmatic Environmental Impact Statement (EIS) related to decontamination and disposal of radioactive wastes resulting from the March 28, 1979, accident at Three Mile Island (TMI) Nuclear Station, Unit 2. This draft supplement (NUREG-0683) addresses the environmental and health impacts of disposal of water generated by the accident or used for cleaning up after the accident. The draft supplement identifies a number of potential alternatives for disposal of the water. These include on-site and off-site evaporation, direct solidification, continued on-site storage, and discharge of the water to the Susquehanna River after further treatment.

After extensive review and analysis, EPA has concluded that there are no significant radiation impacts from the proposed alternatives identified in the draft supplement. For each of these alternatives, NRC's calculated dose exposures are below regulatory limits set by EPA and/or NRC. EPA has therefore rated this draft supplemental EIS LO, indicating a Lack of Objections to the proposed alternatives.

However, because this action involves a new non-routine discharge, EPA recommends that NRC not select either of the alternatives involving discharges to the Susquehanna River. An extraordinary national and multi-institutional (federal and state) effort is presently being implemented toward the restoration and protection of the Chesapeake Bay and its tributaries, including the Susquehanna River. A fundamental part of this restoration effort is to reduce the pollutant burden flowing into the Bay. Therefore, as a general rule, we believe that if there are viable alternatives to such non-routine discharges to the Bay or its tributaries, they should be given great weight.

Finally, because of public concerns regarding TMI and our desire to ensure that the NRC presents the most accurate description possible of the consequences of choosing any particular alternative, we are providing detailed comments to help clarify the basis for NRC's decision-making process.

I have asked Dr. William Kirk (FTS: 590-3909), Director, EPA Three Mile Island Field Station, and John R. Pomponio (FTS: 597-1181) of the Region III staff to provide any needed assistance to you.

Sincerely,

Richard E. Sanderson
Director
Office of Federal Activities

Enclosure

A.52

Detailed Comments
of the U.S. Environmental
Protection Agency on the
U.S. Nuclear Regulatory Commission's
Programmatic Environmental Impact Statement
related to the decontamination and disposal
of radioactive wastes resulting from
March 28, 1979, accident at Three Mile
Island Nuclear Station, Unit 2.
Draft Supplement Dealing with
Disposal of Accident-Generated Water

1. Page V, Paragraph 3 -- We suggest adding "and lesser amounts of other radionuclides" to the second sentence. A table (or tables) should also be added to Section 2 with complete analytic information for all 25 or so compartments where accident water is located. These tables should include results of all analyses done, with Minimum Detectable Amounts (MDA) provided when results are below detection limits.

The Summary here, the data in Table 2.2, and the initial case data taken from the licensee's (GPUN) proposal for disposal of the accident water seem to conflict with the original tank content data provided by GPUN and what is achievable by ion exchange. For example: if Cs-134 is present in concentrations only 2-10 times less than Cs-137 in the untreated water, it will not be totally removed from the treated water while Cs-137 remains.

2. Page xxi -- Add "U.S." preceding "Environmental Protection Agency."

3. Page 2.2, Paragraph 2 -- Is it appropriate to say "very slight traces" for Sr-90 when the achievable (i.e., after initial treatment) concentration exceeds Appendix B, Table 2 (10 CFR 20) limits by a factor of 33, and exceeds the base case by a factor of 367? In the base case, Cs-137 also exceeds the Maximum Permitted Concentration (MPC) in Appendix B, Table 2, of 10 CFR 20. We recognize that the table is correct and, that after final treatment, all standards will be met.

4. Page 2.3, Table 2.2 -- We recommend noting that the base case represents retreatment of 40% of the water as it currently exists and the "achievable" represents 100% retreatment.

5. Page 2.5 -- What is the source of the quoted background levels of Cs-137 and Sr-90? For example, EPA's latest Environmental Radiation Ambient Monitoring System (ERAMS) data published for Oct-Dec 1985 and Jan-Mar 1986 indicate a range of 1-3 pCi/l Sr-90 in milk. A review of data for Region III indicates that concentrations have reached or exceeded 5 pCi/l only two quarters since January, 1975, and have not exceeded 3 pCi/l since September, 1982. Yet, the document lists 5 pCi/l as the background level for Sr-90.

6. Page 2.7, paragraph 2 -- This paragraph suggests that the only time that analysis was done for tritium in the Susquehanna River was in 1977. In fact, daily to quarterly sampling and analysis for tritium and other isotopes are done at 17 locations on the Susquehanna by Pennsylvania or EPA (either TMI or ERAMS) and other locations by several utilities including GPUN. The MDAs for these determinations are all of the order of 200-300 pCi/l, however, and the results are below these levels. These routine programs should be mentioned to avoid giving the impression that no sampling has been done since 1977.

7. Page 2.10 -- Is this 1963 report the latest and definitive data on boron? We recommend that NRC consider more recent references.

8. Page 2.13, para. 4 -- To assure consistency of presentation, we recommend extending the drinking water limit discussion to include all isotopes actually present in tanks.

9. Page 2.14, Table 2.5 -- (1) While we do not believe the results would be affected, we recommend NRC extend the presentation to include all isotopes present in tanks, including a comparison of MDAs to Maximum Permissible Concentration for Water (MPC_w) (10 CFR 20, App. B, Table II) and Drinking Water Limits for isotopes found to be below MDA. (2) The MPC_w for tritium (App. B, Table II) is $3x10^{-3}$uCi/ml, not $3x10^{-5}$ uCi/mi. The drinking water limit is $2x10^{-5}$ uCi/ml.

10. Page 2.15 -- The State of Pennsylvania is in the process of becoming an Agreement State. If this occurs, it could have an effect on the disposal options for the waste.

11. Page 3.1 -- We recommend the use of BEIR 1980 as a reference rather than BEIR 1972.

12. Page 3.2, Table 3.1 (Note b) -- Unless demonstrated to be absent, other isotopes should be mentioned if present in the original tanks.

13. Page 3.14, para. 3.2 -- To clarify this alternative, the standards in 49 CFR 173 for bulk shipment of liquids should be explicitly compared with the nuclide concentrations in the water.

14. Page 3.15, Section 3.2.1.1, para. 3 -- Has in situ vitrification been successfuly tested for quantities of waste this large? Intuitively, it seems the electrical demands would be very high.

15. Page 3.16 -- The assumptions for nuclide concentrations for accident analysis should be explicitly stated. Both the base case and achievable case given in this supplement represent the average case of 2.1 million gallons of water which is actually in 25 separate compartments or tanks with concentrations as much as 2-3 orders of magnitude different from the base case. There does not appear to be any simple way to achieve one uniform batch of water.

16. Page 3.20, para. 3.3 -- Has the risk of transporting cement to the site been considered in the accident predictions for the options involving solidification of water or evaporator bottoms?

17. Page 3.23, Table 3.9 -- The predicted concentrations of Cs-137 in the finished cured concrete are not different from the average concentration in soil in this area. This would not add to gamma exposure since it would, in effect, become part of an infinite slab source.

18. Page 4.9 -- Routine determinations of gross alpha and beta activity, as well as radium, etc., are done by Pennsylvania at many locations and should be mentioned.

19. Page 4.9, Sec. 4.1.3, para. 1 -- What are the units for the water table gradient? Offsite well monitoring conducted by GPUN and EPA should also be mentioned.

20. Page 4.12 -- The description of the vicinity given here should be clarified. TMI is in the extreme NW corner of the area described. Interstate Route 95 and State Route 10 have minimal importance to the area while routes not mentioned (Interstate Rtes. 81, 283, and Rtes. 11, 15, 322, 422) are important.

21. Page 4.13, Fig. 4.7 -- The figure shows TMI to be in the Northeast part of PA instead of the South Central, and does not show routes from TMI to Interstate Rte. 80.

22. Page 5.1, Sec 5.1, para. 2 -- The level of 87 mrem is probably somewhat lower than real per capita background exposure. From the Aerial Radiation Monitoring System overflight data, ambient external gamma radiation ranges from 70-120 mrem/yr. Also, many houses in the TMI area have elevated radon levels, resulting in lung doses much higher than the external gamma levels.

23. Page 5.2, Table 5.1 -- The impact of the Short-Term River Discharge is the same as that of Long-Term River Discharge only if the same river flow is used. If a more reasonable higher flow is used, impacts are much lower.

24. Page 5.3, para. 1 -- We recommend adding "at 87 mrem/yr." before "300,000 people will receive...".

25. Page 5.4, Sec. 5.2, para. 2 -- EPA policy is to use BEIR 1980 values and the relative risk model for calculating risks which, as noted, will yield slightly higher risk estimates.

26. Page 5.8, Sec. 5.4, para. 2 -- The accident scenario described here would appear to be impossible rather than highly improbable since the water is in 25 separate tanks/compartments.

27. Page 5.9, Table 5.2 -- See comment for page 3.2 - Cement transportation.

28. Page 6.1, Section 6.0, Conclusions -- EPA concurs with the NRC Staff's conclusion that no significant environmental impact from a radiological standpoint will be incurred from any of the proposed alternatives.

29. Appendix B is so generally written that persons without a technical background cannot understand how the calculations were made. Many references, including the applicable NRC regulatory guides, are not mentioned. It is not clear how the pathways to man were calculated, what bioconcentration, accumulation, and transfer factors were used, what fish/shellfish species were considered and how food web elements were incorporated into the model. Major clarification or explanation is needed.

30. Page B.1 -- Where do the data for swimming come from? There appears to be very little swimming in the Susquehanna River in the TMI area.

31. Page B.2 -- What is the basis for the shellfish harvest and consumption figures? No references are given.

32. Page B.3 -- What is the basis for 434 lb./yr. vegetable consumption? This sounds high, especially if this is supposed to be local consumption of locally grown vegetables.

33. Page B.4 -- What is the basis for doubling inhalation dose to account for ingestion of contaminated vegetables? This sounds very conservative for Nevada where precipitation, fog, etc., are relatively rare and gardens would have to be irrigated.

34. General. For the sake of clarity it would be instructive to include a section or appendix explaining what estimates of 0.03 or 0.4 or 1.5 cancer deaths really mean in terms of likelihood of having 0, 1, 2, 3, 4 cases or deaths.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
Post Office Box 2063
Harrisburg, Pennsylvania 17120

Deputy Secretary for
Environmental Protection

May 1, 1987

Dr. Michael Masnik
TMI Project Directorate
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Gentlemen:

We are offering comments on NUREG-0683, the Programmatic Environmental Impact Statement related to decontamination and disposal of radioactive wastes resulting from the March 28, 1979 accident, Three Mile Island Nuclear Station, Unit 2.

We have considered the ten alternatives discussed in the report. Based on our review, we recommend against the two alternatives involving direct discharge to the Susquehanna River. This recommendation is based on our concern for the public health and safety of the people in the region and their utilization of the Susquehanna River. Regarding the other eight alternatives, we are making no recommendations. The difference in the potential impacts among these alternatives is small.

Sincerely,

Mark M. McClellan
Deputy Secretary

C002
1/0

Statement of Dr. Ernest J. Sternglass

My name is Ernest J. Sternglass, Professor Emeritus of Radiological Physics, University of Pittsburgh, Scool of Medicine, where I have taught courses and carried out research in the area of radiological instrumentation and the health effects of low-level radiation since 1967. Prior to this, I held a position as Advisory Physicist to the Director of the Westinghouse Research Laboratories, where my functions included the development of Nuclear Medicine Instrumentation, X-ray imaging systems, nuclear radiation detectors and the development of advanced concepts for gas-cooled nuclear reactors. In the course of my professional activities, I have been elected to membership in various scientific and professional organizations, including the American Physical Society, the Radiological Society of North-America, and the American Asssociation of Physicists in Medicine. I have published books, review articles and scientific papers dealing with both radiological instrumentation and the health effects of radiation.

I have examined the Environmental Impact Statement related to the decontamination and disposal of radioactive wastes reulting from the March 28, 1979 accident at the Three Mile Island Nuclear Station, Unit 2 (NUREG-0683, December 1986) as well as related documents and letters furnished to me by the Susquehanna Valley Alliance. As explained in detail in the testimony which I gave before the Citizen's Advisory Board at its March 25th, 1987 meeting, the official trancript of which is made part of the present statement, it is my professional opinion that the proposed open-cycle forced evaporation of the 2.1 million gallons of the accident-generated water containg strontium-90 and other biologically very hazardous isotopes would present a significant risk to the lives and the health of the public, and that alternative methods of handling the problem exist which would greatly reduce this risk at comparable or lower direct costs.

In particular, based on an examination of the mortality statistics for Pennsylvania, Maryland, New York and other nearby states following the previous venting of the Three Mile Island containment building between June 28 and July 11 1980, together with the measurements of strontium-90 released by Harvey, Piccioni and Pisello (1) who found that a comparable amount of strontium-90 was discharged into the atmosphere as is proposed in the planned evaporation option, I estimate that between 100 and 400 excess infant deaths and a comparable number of deaths of adults at all ages, will result from the proposed release.
The basis of my conclusions may be summarized as follows:
1) According to the Environmental Impact Statement (EIS)(NUREG-0683, Suplement No. 2 Draft Report) Table 2.2 page 2.3, 0.9 Curies or 0.9 trillion picocuries are present in the 2.1

Draft Report) Table 2.2. page 2.3, 0.9 Curies or 0.9 trillion picocuries are present in the 2.1 million gallons of water waiting to be evaporated, or at a concentration of 110,000 picocuries per liter (One picocurie is one milionth of one millionth or one trillionth of one Curie, and one liter is slightly more than one quart). For obtain some feeling for the magnitude of this amount of strontium-90 still in the remainig waste water, it should be noted that the bottom of Range II of the Federal Radiation Council Guidelines for the consumption of milk issued during the period of nuclear testing in 1960-61 where concern was warranted and steps to reduce the intake should be considered was only 20 picocuries per liter, and the recently introduced maximum permissible level for drinking water by the EPA is only 9 picocuries per liter. The maximum value measured during the height of nuclear testing was 31 picocuries per liter of milk according to the EIS (NUREG-0683), page 2.9. Thus, the present amount in the stored water would contaminate 100 billion liters of milk to the level of picocuries per liter deemed of public health concern by the EPA, or 30 billion liters to the highest level recorded by the U.S. Public Health Service during the height of nuclear bomb testing.

2) Using the dose factor for infants ingesting food or water containing strontium-90 as given by the Nuclear Regulatory Commision in its publication NUREG-1.109, namely 0.0185 millirads per picocurie, this represents a dose commitment of 16.65 billion millirads to the bone of infants. This means doses of 16.65 millirads to a billion infants, 16,650 millirads to a million infants, or 165,500 millirads to one hundred thousand infants if the strontium-90 in the water were to reach their milk, food and drinking water, regardless of whether the releases are spread out over days, months or years.

3) The EIS assumes that only 1% of the strontium-90 will actually escape into the air with the evaporated water, or 9 billion picocuries. This must be compared with the 50,800 picocuries reported by the NRC in NUREG-0218 as having been released to the atmosphere during normal operation of TMI Unit 1 in 1975, some 177,000 times less. But even assuming that only 1% will escape, the above doses would still be very large. Thus, enough would escape to give a dose of 1,650 millirads to one hundred thousand infants if the amount escaping would enter their diet or the air they breathe. Even assuming still further that only 1% of the amount escaping actually enters the body (1), this would still represent 16.5 millirads for 100,000 infants. But extensive studies by Stewart (2) and others (3) (4) involving diagnostic X-rays during pregnancy have shown that the developing infant is some 100 to 1000 times more sensitive to the development of leukemia and other childhood cancers than the adult depending on the stage of

development. More recently, a large scale study by Kneale and Stewart on the effect of measured background radiation in England involving 22,351 early cancer deaths (0-15 yrs) has shown that only 160 millirads per year, or 40 millirads during the most sensitive first three months of intrauterine development, double the risk of leukemia and cancer (5). Thus, one would expect that 16.5 millirads would result in a 40% increase in childhood leukemias and cancers alone in a group of 100,000 infants born in the years after the release. Since about 1 in 1000 infants normally develop leukemia or cancer, among 100,000 infants, 100 cases would normally be expected. Thus a 40% increase represents 40 excess cancer and leukemia deaths as a result of the proposed method of evaporating the waste water, or 2.5% per millirad. If one were to assume that only the portion deposited on farmland enters the food chain, as did Harvey et al (1), the estimate would be cut to 16 deaths. However, since other long lived isotopes also contained in the waste water have not been considered at all in the above rough estimate, and since the maximum bone dose estimate arrived at in the ESI of 3 millirads is of the same order of magnitude as the 6.6 millirads estimated above assuming only the material deposited on farmland reaches the infant, it is clear that at least of the order of 10 to 40 cancer and leukemia deaths may be expected as a result of the proposed release. This is some 10,000 times more than the 0.003 cancer deaths estimated in the ESI (Section 5.2) based on data for adults exposed to short external radiation doses such as occurred at Hiroshima or in the course of medical diagnosis. But, as explained in detail in my oral testimony of February 25, 1987, these adult populations exposed to short external exposures are not appropriate bases for comparison with infants or fetuses whose DNA repair processes are not yet developed. Furthermore, long chronic exposures by beta rays to crucial organs of the developing immune system such as the bone-marrow, for which the damage is mainly produced by the much more efficient production of free-radical oxygen (6)(7)(8), are some 1000 times more damaging to cell-membranes than short, high-dose and high dose-rate exposures. The much greater mutagenic effect of low dose irradiation than expected on the basis of earlier high dose studies has recently been demonstrated in laboratory studies on single human chromosomes incorporated in hybrid cells (9).

4) However, cancer and leukemia are not the only serious health consequences of the ingestion of strontium-90 and other internal beta-ray emitting isotopes. In the case of bone-seeking isotopes such as strontium-90, it is the cells of the immune system developing in the bone-marrow that are the most critical targets. Studies not considered by the NRC staff or the BEIR Committee on whom the staff relies (Section 5.2) indicate that at doses in the range of

millirads projected for the proposed release, clearly detectable damage to the cells of the bone-marrow has in fact been detected by Stokke et al(10) as discussed in my oral testimony. Still more recently, laboratory studies by Haller and Wigzell (11) have shown that strontium-90 preferentially deactivates the so-called Natural Killer (NK) cells, one of the most crucial components of the natural immune defense system of the human body against viruses, bacteria and cancer cells. As a result, strontium-90 not only increases the risk of developing leukemia and cancer, but also increses the risk of dying of infections, thereby affecting total mortality due to all causes and not just cancer mortality as assumed in the NRC staff's estimates of deaths, helping to explain the gross underestimation of the health risk arrived at in the ESI.

5) Aside from strontium-90, there are a series of other important radioactive chemicals which are contained in the waste water to be evaporated into the air around Three Mile Island such as cesium-137, tritium, carbon-14 and iodine-129. Among the most serious of these is iodine-129 listed in a letter(Document ID 0068P dated February 18,1987) submitted by GPU to the NRC but not even mentioned in the ESI (NUREG-0683). Just like iodine-131, this element seeks out the thyroid gland of the developing infant, where it concentrates as much as 100 times as strongly as in the muchlarger thyroid of the adult (12), except that per picocurie it is much more damaging in its long-term effect because it has a half-life of some 16 million years, as compared to only 8 days for iodine-131, staying in the body much longer and being recycled in the environment generation after generation.

Whereas the NRC staff only considers the relatively small risk of thyroid cancer resulting 10-20 years after exposure, the most critical health effect actually is the reduction in output of thyroid hormone controlling the physical and mental development of the fetus and the infant during the first two years after birth. Even a small reduction in the rate of development of the lung can lead to inability to breathe immediately after birth, causing infants to die of respiratory distress within a few days after birth in much greater numbers than due to all cancers and leukemias combined.

As discused in my March 25th testimony and the article on the Chernobyl accident attached to the present statement (13), it is the underdevelopment of the newborn which rose sharply in the U.S. during the period of fallout from nuclear weapons testing (14) and which appears to be the single most important factor leading to the slowing down in the normal decline of infant mortality. This decline resumed only after the end of large-scale atmospheric weapons testing, but it reached the low rates projected by the pre-war trend only in areas like Wyoming and

New Hampshire where there were no large nuclear plants or other sources of fresh fission products in or near their borders, as predicted by the hypothesis that radioactive iodine and strontium radioisotopes were the pricipal new causal factors in the environment. Since there are about 10 times as many infant deaths due to all causes combined as due to leukemia and cancer, one must therefore expect that some 100 to 400 infants will die as a result of the proposed release. These deaths do not includecomparable number of deaths due to weakened immune systems among older adults and those in future generations due to the long-lived strontium-90, carbon-14 and iodine-129 in the diet for centuries to come, none of which was considered in the ESI.

6) These estimates are supported by the actual increases in infant mortality in Pennsylvania, Maryland,and Upstate New York outside of New York City as published in the U.S. monthly vital statistics following the earlier venting of June-July 1980 at Three Mile Island in which a comparable amount of strontium-90 was discharged. Thus, comparing the six months of July through December after the venting with the first six month of the same year, one finds the following increases in infant deaths:

For Pennsylvania: a rise of 115 from 1032 to1147, an increase of 11.1%.
For Maryland: a rise of 99 from 288 to 385, an increase of 34.4%.
For Upstate N.Y.: a rise of 29 from735 to764, an increase of 3.9%.

For the three areas combined, this is an excess of 241 infant deaths, or of the order expected from the 2.5% increase per millirad for the early infant in the first trimester found by Kneale and Stewart for childhood leukemia and cancer in relation to background radiation in England, Scotland and Wales. In contrast to the above increases, the U.S. infant mortality as a whole kept declining at an average rate of 0.4% per month during this period.

The causal connection of this rise in infant deaths with the radioactivity released in the the venting is further supported by the fact that for the month of July 1980, the number of births in Pennsylvania suddenly rose by 41.4% from 11,358 to a record high for 1980-82 of 16,065, followed by a sharp decline to12,499 in August, indicating that some 4,700 births took place prematurely immediately after the release. Such early delivery leads to a sharp increase in underdeloped and underweight babies, which is known to be the biggest single cause of infant death in the United States today, a rise that began in the early 1950's (14) when

nuclear weapons testing began. A second wave of premature births occurred in October, followed by the largest number of infant deaths in 1980, namely 218 in November, for a record rate of 17.1 deaths per 1000 live births, compared with only 12.5 for the U.S. as a whole that month.

7) The connection with the relase of radioactivity from the venting is further indicated by the fact that when the radioactivity in the environment began to decline following the end of the July 1980 venting, infant mortality for Pennsylvania suddenly dropped at the highest rate ever seen in the entire history of Pennsylvania vital statistics,namely a decline of 36.3% in the two years following July 1980. The number of infant deaths in each six month period and the successive declines as reported in the monthly bulletins of the U.S. Vital Statistics is as follows:

July-Dec. 1980	1147	0	0%
Jan.-June 1981	990	-157	-13.7%
July-Dec. 1981	846	-144	-14.5%
Jan.-July 1982	781	- 65	-7.7%
July-Dec. 1982	731	-50	-6.4%

This sudden decline in infant deaths when all radioactive releases from Three Mile Island Units 1 and 2 ceased is perhaps the most significant supporting evidence that the large radioactive releases from these facilities were responsible for the previous rise. The situation is exactly paralell to the case of the cholera epidemic in London in the early 1800's, when the epidemic ended after a public water pump suspected of being contaminated was closed down

This conclusion is especially difficult to avoid when one examines the decline in infant mortality after 1980 in various states at different distances from Three Mile Island , as shown below by a comparison of the changes between 1980 and 1981 in Pennsylvania, Maryland, New York, and Yermont:

State	1980	1981	Change in No	Change in %
Pennsylvania	2179	1835	-343	-15.7%
Maryland	675	594	-81	- 12.0%
New York	3210	3062	-148	-5.6%
Vermont	63	59	-4	-6.0%

Although these declines in infant mortality in Pennsylvania after1980 probably reflect not only the end of the venting but also the continuing decline of environmental radioactivity produced by the original accident in 1979, the rise in the second half of 1980 relative to the first half cannot be explained as an effect of the March 1979 accident.

Although infant mortality is not the only health impact of the venting since especially the immune systems of older adults are also weakened by the chronic radiation of the bone-marrow produced by strontium-90 and other radioisotopes, it produces the most immediate effects and can therefore be used as an early indicator of serious public health impact of radiation releases into the environment.

Furthermore, present NRC dose calculations must now be regarded as grossly underestimating the population dose. They assume that airborne releases do not enter distant drinking-water supplies even though run-off from agricultural land into rivers is recognized as an important source of drinking water contamination by herbicides and pesticides. Also, they only consider the population within an arbitrary 50 mile zone to be affected. However, as both the above data and the recent experience following the Chernobyl accident indicates, the radioactive gases can contaminate the air, the drinking water and the food supplies far beyond this 50 mile limit. Furthermore, food and milk affected by airborne contamination within a 50 mile radius is often shipped to nearby large metropolitan areas, as is the case for the Philadelphia, Baltimore and Washigton Metropolitan areas within 75 miles of Three Mile Island, so that the existing computer models greatly underestimate the true population size affected by airborne releases.

In conclusion, there is by now sufficient laboratory and human epidemiological evidence of unexpectedly large health effects of chronic exposures to low levels of radiation especially for the developing infant as compared with all theoretical expectations based on the earlier findings for adults exposed at very high dose-rates, that the option of releasing large quantities of strontium-90 and other internal emitters into the air or drinking water can no longer be regarded as accetable

April 13,1987

Ernest J. Sternglass
Professor Emeritus of
Radiological Physics
University of Pittsburgh

References

1) J. Harvey, R. G. Picciomi and D. Pisello, Strontium-90 Released in TMI Venting, Safety in Chemistry and Environment, March 1982.

2) A. Stewart and G. W. Kneale, Radiation Dose Effects in Relation to Obstetric X-rays and Childhood Cancers. Lancet 1: 1185 (1970).

3) B. MacMahon, Prenatal X-ray Exposure and Childhood Cancers. J. National Cancer Inst. 28, 1173 (1962).

4) A. M. Lilienfeld, Epidemiological Studies of the Leukemogenic Effects of Radiation, Yale Journal of Biology and Medicine 39, 143(1966).

5) G. W. Kneale and A. M. Stewart, Childhood Cancers in the U. K. and their Relation to Background Radiation, Proc. Int'l. Conf. on Biol. Eff. of Ionizing Radiation, Hammersmith Hospital, London, November 24-25, 1986.

6) A. Petkau, Effect of Na-22 on a Phospholipid Membrane, Health Physics, 22, 239 (1972).

7) E. J. Sternglass, The Role of Indirect Radiation Effects on Cell Membranes in the Immune Response, Proc. of the 1974 Hanford Radiobiology Symposium, Div. Tech. Inf., ERDA, Oak Ridge, Tenn. (1976) (CONF-740930)

8) A. Petkau, Radiation Carcinogenesis from a Membrane Perspective, Acta Physiol. Scand. Suppl. 492, 81 (1980).

9) C. Waldren, L. Correll, M. A. Sognier and T. T. Puck, Measurement of Low Levels of X-ray Mutagenesis in Relation to Human Disease, Proc. National Acad. of Science USA 83, 4839 (1986).

10) T. Stokke, P. Oftedal and A. Pappas, Effects of Small Doses of Radioactive Strontium on the Rat Bone Marrow, Acta Radiologica Therapy Physics Biology 7, 321 (1968).

11) O. Haller and H. Wigzell, Suppression of Natural Killer Cell Activity with Radioactive Strontium: Effector Cells are Marrow Dependent. J. of Immunology, 118, 1503 (1977)

12) W. H. Beierwaltes et al, Radioactive Iodine Concentrationn in the Fetal Human Thyroid Gland from Fallout. J. Am. Med. Assoc. 173, 1895 (1960).

13) E. J. Sternglass, Implications of the Chernobyl Accident for Human Health, Int'l. J. Biosocial Res. 8, 7 (1986).

14) K.-S. Lee, N. Paneth, L. M. Gartner et al, Neonatal Mortality: An Analysis of Recent Improvement in the United States, Am. J. Public Health, 70, 15 (1980).

ERIC EPSTEIN: In that this is a very sensitive subject, I think that the panel should not rigidly enforce time constraints on questions and presentations by the community. And in addition, I think you have already addressed this, I hope the water disposal issue does not become a secondary item after this meeting.

I do appreciate the fact that GPU responded to my questions concerning post defueling monitor storage; however, I am not satisfied with a number of the responses, especially the ones dealing with decommissioning. And rather than pursue a line of questioning tonight, I will defer to the next meeting if that is okay with you, Mayor.

[Discussion]

I am submitting a list of questions, about 22, to the NRC concerning their revised Environmental Impact Statement. I request that they be made a part of the official record. And rather than distribute them to you right now, I think it would just distract from my presentation, I will give it to you later.

Tonight I am speaking on behalf of Three Mile Island Alert, which is a nonprofit safe energy group based in Harrisburg.

Both the NRC and GPU have stated that the quantities of radiation released during the disposal of the contaminated water would be insignificant. But we must realize that they always say this. We don't believe that any radiation dose is safe, especially in this area where radiation has been vented steadily for the last 14 years.

I don't remember a time when the utility admitted that significant levels of radiation have been released, including the 43,000 curies of krypton-85 vented on central Pennsylvania for 13 days in July of 1980.

We have serious reservations about the disposal options sanctioned by the NRC. In fact, disposal is an incorrect term. There will be no actual disposal and no guarantee of containment. Instead, radioactive materials and industrial chemicals will be dispersed in the environment.

We do, however, have certain objectives we would like to see met. Our prime and overriding concern is minimizing radiation exposure to the local population and the environment. For example, we would like to see 100 percent of the water filtered and processed within a closed cycle.

We also think that workers' exposure should be minimized since many of them have been human sponges for the last seven and a half years.

Dose rates to populations outside of central Pennsylvania should also be minimized.

In addition, cost and time should not be factors. GPU should spend as much money and take as much time as needed to find the safest method of disposal.

Considering these objectives, alternatives such as dumping the water into the Susquehanna River and on-site evaporation are clearly unacceptable due to the potential harmful physical and psychological threat that they present to the community.

We do request the following steps be taken before a final decision is made: A meteorological study of the area surrounding TMI; a study examining the psychological stress that would result from the planned

disposal methods; an inventory of all the radioactive elements and chemicals that are in the water; and a review of the GPU's current proposal and the NRC's revised EIS by an independent agency not affiliated with the nuclear industry of the Government.

At this time I would like to remind the panel of some of the past behavior of this utility and the NRC, because this is a crucial factor in understanding the built-in distrust and fear of area residents.

We remember that in July of 1980, 43,000 curies of radioactive krypton-85 and other radioactive gases were vented from Unit 2, even though TMI 2 was designed to release approximately 770 curies of krypton-85 a year. The venting occurred a little over a year after the accident amidst widespread fear and concern. Later in November, the U.S. Court of Appeals for the District of Columbia ruled in Sholly versus the NRC that the krypton venting was illegal.

We remember that in the spring of 1983 three senior-level engineers charged that GPU and Bechtel deliberately circumvented safety procedures and then harassed them for reporting safety violations. The NRC fined GPU and Bechtel $64,000 for intimidating and harassing Larry Parks.

And, of course, we remember the reactor head lift between July 24 and 27, 1983, which was delayed due to brake failure on the polar crane. GPU vented radioactive gases into the environment despite pledges by the NRC and GPU that no venting would take place during that head lift operation. GPU was later fined $40,000 by the NRC for the brake problem.

We remember that on June 1, 1984, the NRC released transcripts of closed NRC Commission meetings. The transcripts revealed a commitment on the part of the Commission majority to restart TMI 1 as soon as legally and politically possible.

Also evident was a significant disdain for public views on the restart issue and a serious lack of understanding of the legal and technical issues. This is the same agency who will ultimately decide how the water will be disposed.

We remember that between February 10 and 12, 1985, the Philadelphia Inquirer reported records at TMI demonstrated that in hundreds of cases, workers had been contaminated by radioactive materials either on the skin or through ingestion. The result was that workers were living in a state of anxiety, fearing cancer, birth defects, and possible genetic damage for future generation.

We also remember the health suits, the spills, the fines, the leaks, the miscalibrations, the exposures, the criminal convictions, and the one-celled organisms.

So when the NRC and GPU say venting, dumping, or burying 2.1 million gallons of radioactive water will have a negligible impact on our health and environment, people just don't believe them. Why should they?

People live with a fear that they and future generations have suffered serious health effects as a result of the accident and GPU's mismanagement. This fear has fostered a great deal of psychological stress in our community. Stress can be translated into long-term health effects, and they are very difficult to measure. Yet it is one factor that the NRC will not identify in measuring health risks from the disposal of the water.

Let me conclude by saying that we are not scientists and we do not feel that the burden of producing a safe and expedited method of disposal should fall on the shoulders of the community. The decision on what to do with this water should not be made in haste and should not be made until all possible alternatives are explored and exhausted.
People in this area have been dumped on enough. I think we are just tired of being the guinea pigs. That concludes my official statement.

GORDON ROBINSON: What agency, independent agency, would TMI Alert recommend?

ERIC EPSTEIN: I don't know what agency. It maybe doesn't have to be an agency, but people that aren't tied to the industry or the Government would be helpful to us.
Of course, whoever we recommend, I am sure the utility and the NRC would resist as being bias or subjective, but that is the same kind of bias we feel with the NRC and perhaps the utility have done.

GORDON ROBINSON: Have about EPA?

ERIC EPSTEIN: EPA again is a government agency. And, you know, Bill is a nice guy and all that good stuff, but EPA if you look at the way they have handled chemical issues throughout the country, it has not been real good.
So if you would like, I can get a list of folks; and if you would like to forward them to the NRC, I would be happy to do that.

GORDON ROBINSON: I would like not a list of folks, but hopefully some group or agency or something that -- yes, I would like a list.

ERIC EPSTEIN: Perhaps "folks" is not the best terminology. But I can produce that if that would help you.

KENNETH MILLER: In your opening statement dealing with the water, you mentioned the fact that you would like to see the water filtered through a closed-loop system.

ERIC EPSTEIN: Right.

KENNETH MILLER: What do you have in mind there?

ERIC EPSTEIN: I don't know what I have in mind there. But one of my questions here is that they had to make an adjustment to the filtering system that is usually not closed; and I was wondering, if they had to make an adjustment to open it, why they couldn't keep it closed? And that is one of the questions I had submitted to the NRC.
Here it is, Question 5, "Why not let the transportable evaporator operate in the closed cycle?" And I asked, "How accurate has the volume reduction figure been in other plants?"
Rather than go into that, it deals with the specifics of the EIS. I don't see why it has to be open and vented. That is my main question. What are you having a problem understanding?

KENNETH MILLER: I don't see how you accomplish anything with what you are proposing. Basically you are just running it through a closed system and accomplishing nothing.

ERIC EPSTEIN: What I am asking is that it be processed and cleansed as much as possible. I notice on proposals that 50 percent of the water is -- why not 100 percent of it processed and gleaned for as much chemical elements as possible?
What not go the extra yard? is all I am saying.

ARTHUR MORRIS: Are you suggesting further filtration of sorts; because if you are talking about a closed evaporation system, the idea really is to reduce the volume. And if you are not going to reduce through evaporation, then the volume stays the same.

ERIC EPSTEIN: I mentioned evaporation is unacceptable to our group, so I think they should probably deal with that.

ARTHUR MORRIS: So you are talking about further filtration?

ERIC EPSTEIN: And processing. You still look befuddled, Ken.

KENNETH MILLER: I guess I just don't understand what the end point would be that you have in mind by doing this.

ERIC EPSTEIN: Well, I don't think there is an end point.

KENNETH MILLER: If you are not going to evaporate the water, there is no point in further filtration.

ERIC EPSTEIN: I am not going to sit here and take other people's time bantering back and forth with you.
[Discussion]
All I need for the next meeting is a written list of individuals and agencies for you?

GORDON ROBINSON: Yes, if you would.

ARTHUR MORRIS: The next person who asked for time is Frances Skolnick.

FRANCES SKOLNICK: Frances Skolnick.
I am speaking for the Susquehanna Valley Alliance, a safe energy organization formed in 1979 to prevent the disposal of the accident-generated water into the Susquehanna River, our drinking water source.
The SVA established as one of its goals the safe disposal of this radioactive water. And we are as committed as ever to achieve that goal.
I am speaking here this evening to raise major concerns with this panel about the disposal of the water, with the hope that its members will seriously study and evaluate these concerns and find suitable answers and explanations.

I believe that it is important to clarify certain points about this radioactive water, estimated to be about 2.1 million gallons. But who knows at this time whether or not it might amount to 3 million or even 4 million gallons when end-point is reached, an event whose definition has not yet been clarified.

All of this water is not sitting in tanks on-site just waiting for disposal. It is stored in various locations, including the reactor core system covering the damaged and melted fuel and in the reactor building sump, the area where presently only robots may go because it is so highly contaminated. Therefore, a large quantity of this water about which we speak is still in contact with highly radioactive elements.

Furthermore, it is my understanding that this accident-generated water is to be used for flushing and washing out the system after defueling. Defueling is a hazardous procedure which continues to meet with obstacles and time delays, including the growth of micro-organisms and the inability to get the chunks of material broken up.

Which brings me to our concern about the presently listed contents of this water. To list tritium, strontium, cesium, boron and sodium only serves to simply the matter and insults yours and my intelligence.

Unit 2 ran for a matter of months before it expired, and not at all gracefully. According to Dr. Carl Johnson, M.D., M.P.H., as many as 500 radioisotopes are formed during the fission process. Fifty-two of these transuranics are formed. Some of these transuranics are less toxic; however, some are highly toxic to man, including plutonium. Another transuranic, nepunium-239, after a short life becomes plutonium. When plutonium and similar radionuclides enter the tissues and the body of man, they become a permanent resident in the body and continue to emit alpha radiation. The excretion rate is very slow; about one-half would be excreted every 200 years.

In animals plutonium causes cancer of the lung, bone, kidney, mammary gland, lymph nodes, nesothelium and ten types of soft-tissue cancer. Transuranics are soluble in water. Indeed, they were found in the water in Denver, which is downwind of Rocky Flats and also in Broomfield, close to Rocky Flats. Excess cancer incidence has been reported in those areas.

It seems crucial to us then that this water is tested independently and with sophisticated alpha radiation monitoring equipment, starting right away, and continuing for the duration of the cleanup.

We demand a table of contents of the water, which would include a list of the transuranics. Telling us that a radioisotope is below detectable limits is not enough. We need assurance that the correct equipment is being used to detect transuranics, and what the lowest detectable limit is for that machine for each radioisotope. Then and only then can we evaluate the health impact of any of these methods of disposal.

Dr. Carl Johnson also advised me about the alpha recoil effect which causes particulate matter to pass through filters. Dr. Johnson would be more than pleased to come before this panel and explain the whole matter of transuranics.

What we also need and want to evaluate is an inventory of the core prior to the accident, the amounts which have left the area and their content; then we can estimate the radioisotopic content of what is left.

Other elements not listed in the table of contents, and which must be listed in order to make an evaluation of the disposal methods, should include the chemicals used in the decontamination solutions and the oils and greases which were clearly alluded to in the Environmental Impact Statement of 1981.

We do not want to be told they are below detectable limits. We want to know quantities and concentrations used to date and projected quantities and concentrations up to the end-point.

It is also imperative that we know how this water would be processed prior to disposal, since concerns have been raised in the Environmental Impact Statement of '81 about chemically-laden water clothing the Epicore and the SDS systems and causing them to work ineffectively.

What we are suggesting, therefore, is that it is premature to consider the disposal of a liquid whose contents are not yet clarified and could change.

We believe that it is unwise to give GPU Nuclear the freedom to dispose of this water by a certain method when, perhaps in six months or year, we could discover that the Epicore or the SDS is no longer adequate for treating this water, and the method selected for disposal would no longer prove adequate and safe.

I have addressed the tritium content of the water and its possible health consequences in my last statement to this panel. It is not the innocent radionuclide which the NRC and GPU would make us believe. It is more likely to have been deemed innocent because of the unavailability of technology to remove it from water.

Tritium is the unstable element of hydrogen and has a half-life of 12 years, which means it is will be toxic for 120 years.

Experiments with tritium have concluded that tritium does have negative effects upon organisms. These experiments include those by Dobson and Cooper, who concluded that there is no threshold below which reproduction in mice is not adversely affected. Zamenoff and Martens observed that mice who were continually fed low doses of tritium suffered brain damage. Experiments conducted by Mewissen and Ugarte to determine the cumulative genetic effects from exposure of male mice to tritium for ten generations led to a reduction in the off-spring and a rise in infant mortality.

Since the preferred chemical state of tritium is water, it has free access to our bodies and other living organisms. It can enter into our bodies in three ways: (1) inhalation, (2) ingestion, and (3) absorption through the skin.

It readily enters into our food chain through plants and animals who are subjected to the same contaminated environment. We are not only talking about the people, plants, and animals of central Pennsylvania, but also those of the Chesapeake Bay and Baltimore area.

Our conclusions about tritium and its adverse health effects lead us to press for greater efforts to isolate this radionuclide from our environment. It just isn't good enough or acceptable that thousands of curies of this radionuclide is allowed to contaminate our water and our air.

I wish to draw your attention to a document. It is NUREG CR 39773 prepared for the Division of Waste Management Office of Nuclear Material Safety and Safeguard, the Nuclear Regulatory Commission, by Brookhaven National Laboratory, Department of Nuclear Energy, which discusses

alternative containers for low-level wastes containing large amounts of tritium.
The availability of these recommended containers whose life span is up to 250 years would give us an option of maintaining that water on-site in a safer manner than at present.
The impact of the disposal of this water on our health cannot be seen outside of the context of all previous, present, and future releases of radiation into our environment, from not only TMI but all the other nuclear plants and industries releasing radioactivity.
An overwhelming amount of data have been accumulated that show there is no safe level of exposure. And there is no dose of radiation so low that the risk of developing a malignancy is zero.
It is evident also that all persons do not run the same risk of developing a malignancy from a given radiation exposure; and that the risk of some types of cancer is greater for some people than for others.
The data presented by the NRC concerning risk of exposure to the population by any disposal method is both controversial and not acceptable to us.
There was, indeed, an air of flippancy in the NRC document considering disposal methods. Two of these methods should never have even been considered at all since they are not available: Those include the dumping into the ocean, which is banned by international treaty; and the other is the use of Maxey Flats, which as a low-level waste site has been closed because of leakage.
When the Nuclear Regulatory Commission discusses dilution as a possible means of reducing population exposure to radiation, many reputable scientists scorn that idea.
In a conversation with Dr. Richard Piccioni, senior staff scientist for Ascord Research of New York, he said, and I quote "On the basis of the linear model of cancer risk and radioactive exposure, it follows that it doesn't help to dilute the radioactivity into the environment. It only allows them," meaning the NRC and GPU, "to get below certain legalistic limits."
We were deeply horrified and insulted when Dr. Travers at a recent Harrisburg meeting informed us that this water was not pure enough for the nuclear power plant's pipes, however, it is being considered to be put into our environment.
It is evident that this document and the future disposal of the water needs close scrutiny by independent scientists. I believe this panel must convene before meeting with the Nuclear Regulatory Commission to do exactly this.
If any method is given approval at this time, we feel that we are giving GPU Nuclear license to further disregard any problems which will undoubtedly arise with this water.
We do not trust GPU Nuclear with preserving the integrity of our environment. Their track record validates our position.
Our message to you and the NRC is clear and simple. There must be independent review of this document, not only by way of letter to the NRC but through this panel and in the form of a public meeting. This organization has independent scientists willing to come forward.

We will on no account tolerate this water being disposed of into the water or the air. We need further research and discussion on the method to keep the radioactivity from entering our environment.
We intend to use all our resources to achieve the goal of this organization, which is to see the safe, and I repeat safe, disposal of this radioactive waste.

BETTY TOMPKINS: Betty Tompkins.
I am Betty Tompkins and I live there. You are lucky I lost half my notes.
If I was convinced that health and safety issues were primary, both with the NRC and GPU Nuclear, I could have attended my Sunday school class teacher's meeting this evening; however, it is not my policy to deal with convicted criminals or to believe them.
I am not a physicist; but more importantly, I am a citizen of the United States of America which guarantees me the right to the pursuit of happiness. For the last eight years, this has been -- my right to such has been denied and it continues to be denied.
As I listen here this evening, I couldn't help but be reminded of a court of law where sometimes truth and justice is desolved by how good the two lawyers are. And we heard -- a lot of preparation has gone into it by staff people, by paid people. We are just volunteers, but we have done our homework. I concur with the last two speakers.
One of the things that really gets to me, and it says right here, is that the TMI 2 license currently prohibits disposal of the accident-generated water and will require amendment before any disposal maybe performed.
I think the whole -- this is premature. There is a lot of homework that they have to do and they have not done it. There is a lot of things that they have to concur with. DOE must give its approval. The TMI license does require amending.
I cannot understand why a damaged reactor even has a license. That is a real puzzle to me. I just don't understand that. If a person is sick, they are given a power of attorney because they are considered to be incompetent to manage their affairs. But a nuclear reactor can still operate on its same old license. It puzzles me.
There are lots of things that have to be done. The amount of strontium-90 and cesium-137 to be released during evaporation, the amounts are undetermined and will depend, it says in here, on the design of the evaporator and how many times they lift the lid, however that does happen.
The time for public input on this has been 45 days. It is not enough. I really tried to do my homework. I got this about two weeks ago through the mail. I have read halfway through it and made comments. And for us to -- the public just to have 45 days to comment is not enough. There is a need for public meetings to comment on this and for the public to have adequate input.
The Pacific Northwest Institute and the Department of Energy seem to be together. There is no -- I don't see any independent surveyor work done here. The tritium concentration in the Susquehanna River was measured ten years ago. There needs to be an update on that. It says that right in there, "ten years ago." It probably has changed.

It says it will be monitored. We have come to realize -- the releases -- whatever system they go with, they say the release of radioactivity into the air, the water, or anywhere will be monitored. It has been our experience that monitoring is a very loose term unless we sit on them night and day to see that they are monitoring it properly, and have the proper things to do it with.

I think I said that about the small amount of the cesium and all that other stuff that goes into the air.

I don't have very much to say today. I am not a physicist. I said that at the beginning. I am a citizen here. I have studied this for eight years. I don't think that it is my responsibility to come up with an adequate way to dispose of this water.

In my innocence, I would say let it sit on-site and decay naturally. I have heard the young lady back here, I think she is probably a scientist, say they didn't really come up with any one way that was preferable over any other way. I think that needs to be considered.

I also believe, I really believe that there ought to be some real concern about the health and safety of the persons downstream. We can't all live upstream. And I don't think that has really been given a lot of consideration.

We met with DOE one time. I know people who tied up into a lot of this technology, and health and safety doesn't seem to be a primary concern. It needs to be. We live here.

And to expedite for the sake -- and I know it has been answered, but not to my satisfaction, that in the expedition of the removal of the water, dollars have not counted into it. I believe it has.

So I would ask this panel (1) to ask for an independent study; and (2), to give some direction to GPU. Not to let -- sometimes it is the tail wagging the dog. And we need to be telling them how we would like it cleaned up and what we would like them to do with our environment, not just listening to them and letting them floor us with all the technology. I believe, I think I said that I had an eight-year course and failed it. I would believe if all the panel was given a test on what was said tonight by the experts, I believe that you might get a C or something because it is difficult to follow along with what they are saying.

So take that into consideration. Ask for an independent study, public hearings, and send them back to the drawing board.

[Discussion]

DICK BROWN: My name is Dick Brown. I live in Lititz. I am a science teacher. I have been involved in the environmental movement probably for 20 years.

Several years ago I spoke to the NRC representing the Lancaster Environmental Action Federation on our position opposing the restart of Unit 1. I am speaking as a citizen tonight. I am not representing any entity except myself and my own experience.

One of the things that I found in the NRC's presentation that disturbed me was the calling of the tritium, radioactive nuclide. What we are really talking about is radioactive water. The stuff that we are talking about releasing is radioactive water. It is not a little big name thing sitting around just giving off different kinds of radiation. It is a

water molecule that just happens to have a hydrogen in it that is radioactive. It is H_2O.

H_2O makes up 70 percent of our body and covers 72 percent or 71 percent of the earths surface. It is found in every living thing on this planet. And, yes, there is some tritium water in nature. It has been there for probably billions of years. But in the concentrations we are talking about, it doesn't exist that way.

The problem I have with this release is that the tritium water that would be released or evaporated from this waste would be allowed to enter all of our environments. It would act as all water does. This water would form as dew on the leaves. It would become snow. It would become rain. It would be part of the water of plants as they absorbed it after the rain into the roots. It would become part of their system. Every animal that eats that plant would then absorbed that tritium water into their bodies.

All of us would eat plants raised in the most productive nonirrigated county in the United States. We would be part of the system. That tritium would become part of the ecosystem of this country or other surrounding areas.

It would not go out into the ocean or somewhere else. It would end up, a lot of it would end up here, as the water that is already here. And my concern is that it shouldn't be introduced into this system.

What should be done, in my opinion, is taking the first alternative, which I think is probably in some respects good; and that is to separate the tritium water and the other water that is not tritium contaminated from the other radioactive materials.

That water should not be evaporated into the air but should be distilled. You know what a still is. We simply take the water and recollect it by cooling it. Then we have just the tritium water minus as much of the crap as we can get out of it.

Then we find a way to take that tritium water and put it somewhere else, but not in Lancaster County. And I think that is what has to be done. I don't believe it should be released in any way, shape, or form in this county, stream, air, or anything else. And it should be taken off site, as should the other waste as well.

ALAN BRUNS: I am Alan Bruns. I live in Lancaster and teach at Franklin and Marshall, teach physics.

I want to second the concern of one of the people who spoke of the transuranic elements. Now, that may have been dealt with in another report; but I didn't see it at all in this report, and I have not read on this reports.

They are produced in large quantity. They were produced in large quantity while the reactor was acting. And all that has been exposed to the water that we are contemplating discharging.

To give you some figures that will indicate the severity of this, I refer to a book -- well, I can't seem to find it. I must have left it at my seat back there, but I have the figures.

It is a book written by four authors who are from the Energy Institute in Palo Alto, so it is a substantive book. It speaks of the dangers in reprocessing materials, which isn't being done now, but in a sense we are

dealing with materials in a state which normally would be reprocessed. The most dangerous is cesium-137. But only 10 percent as dangerous is americium-241, which is produced in a quite a large amount. And curium-244, which is one-tenth as dangerous as the cesium.

Now, the study or the report seems to indicate considerable attention to the cesium problem, but I see no mention of americium or curium. Plutonium has a danger which is lower than that.

Another way to indicate to you the significance of small amounts of these transuranic elements is to give you, out of that same reference again, figures on the concentrations that are allowed for materials.

Plutonium-239 if discharged into the water is allowed to have a concentration of .1 pCi/1 above natural background. Now, I don't know whether that is in the direct discharge or after it rumbles around in the river a little bit and mixes up above the dam or not.

That converts to .0001 pCi/ml, which is one one-hundred thousandth of the achievable strontium-90 after retreatment. So we are dealing with figures which are extremely small for these alpha remitting transuranics compared to cesium, strontium, and tritium, which the report addresses.

Again, to give you a feeling for how tenuous that concentration is, you get 10^{-4} pCi/ml if there is but 1 atom in 10^{16} plutonium. If it is discharged into the air, that same table in that reference which I can supply, it says that you can have a level of 2×10^{-9} pCi/1 of air. That is unbelievably small.

I don't know what that converts to in terms of concentration, but it is certainly infinitesimally below parts per million.

So I just want to give you those figures as a way of trying to impress upon you that what this other person said, who is not a scientist whatsoever, I think has behind it some concerns that bear out the request to get definitive statements on what is the concentration of the transuranic elements that we are dealing with.

AL MANIX: I am Al Manix. What I want to state here is I did some research and I was quite concerned.

I would like to help the good people in Lancaster County and Dauphin County get rid of this junk. I went to Manly-Regan Chemical Company. I was concerned. They were shipping chemicals in and out almost every day. They are a pretty busy outfit. They are not real big, but they are busy. I stated to them that I had a problem; that if we shipped this material out by railroad tank cars, how would it go. They said one tank car carries 10,476 gallons of water. So may be we need 200 tanks cars, and everybody in Dauphin County and Lancaster County would be real happy.

In case anybody wants that again, I will give it to you, or you can call up any chemical company and they will tell you what size tank cars they are using and what sizes are available, or you can call the railroad people for that matter.

Thank you.

BEVERLY DAVIS: My name is Beverly Davis.

First of all, I think one of the main problems that people have with this plan or any other plan is that we do not trust, as has been mentioned before, the inventory of what is actually in this water.

When it has washed against the fuel in the reactor coolant system for some years here, it seems unbelievable that there are only seven elements that were not able to be filtered out of it. Just one resource that I read said 36 elements, and that wasn't even counting transuranics, would be manufactured in there, in the process of creating electricity.

Another thing that we do not trust is the fact that, even though we are given these as absolute figures, it appears that we have only monitored and have only filtered or tried to filter certain things. The SDS system has worked hard at getting cesium. The EPICOR worked hard at the strontium. The efore, we seem to have good figures at cesium and strontium.

I am wondering if there are a lot of other things that we either do not have the technology for or simply have not been listed that should be included.

Another thing that we have a problem with is the sources of all the water. We keep hearing about outfall, and maybe that is only the water which comes from rain which is collected in potholes on the island. I am not really convinced that is the only kind of water that is coming out of the outfall.

The additional water which would be used at the end of the time process, which would be in the fuel canal, I am not sure whether that water is included in what we are talking about or not. That would seem to me to be highly contaminated water. The water which, I believe if I am not mistaken, is now over sludge in the basement in order to contain the radioactivity, is that water included in this inventory? We are not sure that all of it is being trapped by the filters, as I said before.

Going back and reading some of the earlier drafts and reading some of the earlier information, it appears that there were fines which are not filterable. One of the reasons that they were not able to be filtered is they clung to boron in the water; and they, therefore, were not separated by the normal natural processes that were being used.

I was also told at least twice here that transuranics were not soluble. Therefore, we didn't need to worry about those being steamed out of the water, yet I read that there are different kinds of transuranics.

I don't know which transuranics are contained within here, whether they are all actually nonsoluble or not; but I understand there are different kinds, some are more soluble than others. We have not received all of the scientific studies which might bear on the release of what has already been delivered to us from this plant.

For instance, the Public Health Fund has never released the study by R. Patrick, as far as I know. That was supposed to be giving us accurate information or up-to-date information, as I understood it, about what might have gone through the food chain or might have been in the sediment in the river.

What we have already gotten has got to be considered in this. And I think that that is one of the things that bothers people a lot, is that there has never been any kind of a definitive cumulative total given of what we have already acquired as a public from this plant.

We keep saying, Well, this is just a little bit more. We don't mind adding a little bit more of this and a little bit more of that. The public does not feel very secure about that because we feel that the

cumulative dose adds up to a lot more than these minuscule doses that people keep talking about.
We don't trust GPU that they could deliver any kind of a release of anything. They have not been able to be trusted to do anything right up to this point. They always make mistakes. They always have technical difficulties. I don't think anybody in this public trusts them to do anything in terms of even the release of what you are saying is a very low level of radioactive water.
One of the things which is not included in the report which bothers me a lot is that there is no evaluation in the environmental section of the report on the fact that this is a closed-air basin. I don't know what the technical term is for it, but I know that a certain burning is prohibited. I know that we have many inversions.
I know that along the river we are subject to fog. I know that from reading some other things, that the aerosol effect of radionuclides being injected is maybe different in a biological sense than to simply receive them as particles or as air gases.
Mainly, I think the biggest thing is that people are concerned here that you have not evaluated the effect on people. And I don't mean in terms of taking a technical reading of what radionuclides they might absorb through this.
What we are talking about is public policy. And if I may give you a very crude simile on this. I have a septic tank in my backyard. And when it fills up after ten years or five years or whatever, I have someone come in and pump it out and take it away.
I can live with that septic tank full or empty in my backyard and with the possibility that it might leach. But I cannot live with the possibility that someone is going to take a bucket and dump it over the head of everybody in my family. I think that is the way the people in this area feel.
They feel that when the krypton was vented out, the public policy had not up to that time said -- they had said that there were caustics, there were chemicals, there were things that might leach, there were things that might accidentally escape. There could be all sorts of transportation accidents.
But for the first time in my knowledge, or in my experience, a whole public was told that we are going to give it to you. We are going to push it down your throat. We are going to give you toxic material, which we agree is toxic, which could be detrimental to your health. And we are going to give it to you because we want to get rid of it. We don't know what else to do with it, and we are going to give it to you, the public, and let you absorb the dose and then figure out the consequences.
I think that is despicable public policy. I think that is what is happening again. And I think that is what is bothering people, more than even knowing whether there is very much radioactivity in this water or not. It is the insult to the population that is being told we are going to dump some more junk on top of you.
We don't know what we have gotten already. We know that we have already been exposed to this at least once, this kind of public policy. We have another dose coming at us, and people are saying, Don't worry. It is fine. Nothing to worry about.

I believe that the public would react most favorably to leaving that water on-site in tanks where it is contained. It is not being dispersed. It is not being evaporated. It is not being put down the river. It is not being put in their drinking water. It is being contained.
I resent that in this report and also in the report that was given the other night, that there is an adjective of "merely." We would merely hold this on-site, as if there was nothing to be gained by holding this on-site.
As I read the half-lives of the elements which are listed by this report --
[Interruption]
One-half a minute.
The greatest half-life that I understand in the elements that are listed is 30.2 years.
Apparently the license allows at least for this to be stored through the half-life of the most dangerous or the most long-lasting element that is in here. There would seem to be a great deal of advantage to that.
If you have to come along and pump out the septic tank at that point, that is another problem that somebody maybe can take care of. But until that time, I am very happy to have it sitting there in stainless steel tanks.
The only difficulties that I would see with that is the danger of floods, the dangers of ice jams, which Jeff Minik evaluated and nobody else has evaluated in any of these things in terms of what is happening on the island. Those are the only problems.
There is one little thing in the report that says something about the vents in the tank allowing evaporation to occur from these tanks, even if they sat there. That bothers me a lot.
But there seems to be very little against it. This panel has two missions, as I see it; one of the missions is that a lot of you on here are scientists, very distinguished scientists with a background of solid scientific information. We depend on this panel to give us that third-party scientific background to educate us and to ask the hard questions of the people that come forward.
The other thing we depend on the panel for is to convey and to establish public policy. And I would hope that both of these things would be addressed by the panel.

DEBRA DAVENPORT: I am Debra Davenport, Concerned Mothers and Women.
I just wanted to briefly say that I am also definitely thinking that this should be retained on the site temporarily, for a period of years, perhaps, until some other sites can be determined or a way to transport that water out of there can be thought about; or it should be taken to Nevada, which is clearly cheaper than evaporating waste on-site.
And in reference to that, I do have one question. Why evaporate and what will this cost? What will it cost to run the heaters? And who will provide that energy? And what will that cost? Will it cost the consumers?
[Discussion]
So there is some possibility that the consumers would have to pay for that?

FRANK STANDERFER: The monies for the evaporation of the water are included in the current total estimate for the cleanup.
It would be covered within the $965 million which we have set as the cleanup costs. So they are budgeted.

DEBRA DAVENPORT: That's all I wanted to know.

ELIZABETH SHIVA: Elizabeth Shiva (phonetic). I live in Middletown three miles from TMI. I would like to speak on behalf of the Concerned Mother's and Women and my many neighbors who were not able to be here tonight.
First of all, we do not have any faith in GPU, their directors of the cleanup, and the same loss of faith in William Travers of the NRC. We do not believe their quoted figures of percentages of radioactive doses to be released during the venting over an excruciating two-and-a-half-year period.
How can they know the doses that will be relased when they don't even have an idea of the amount of molten waste or a way to remove it? We have much less faith in the so-called facts and figures spouted off to the press by Gordon Tomb and Lisa Robinson. They are wasting their breath and our time.
I would like to know if Gordon Tomb's and William Travers' families will live in Middletown or the surrounding areas during the two-and-a-half-year venting period?
How dare you do this to us. My God, do we have to live through this for another two and half years?

DORIS ROBB: I am Doris Robb.
The last time I addressed this group I had asked a question of you, Mayor Morris, about the monitoring system for the water in Lancaster. At that time you told me to contact Michael Friedman, whom I did, and ask him questions about the type of system that we do have in place. That was the system that we received in Lancaster following the suit that we had against GPU Nuclear after the accident at Three Mile Island.
He told me at that time he was not able to find out the name of the system, and that didn't really make any difference to me. I wasn't really concerned about that. But I did ask him what the system was equipped to monitor. And he said it is a gamma monitor.
I notice from the presentation tonight that tritium and strontium are both beta emitters, and that also strontium is a beta, as well as a gamma, emitter. And so I am very concerned that Lancaster County really doesn't know, or the City of Lancaster, doesn't know what may be coming from Three Mile Island in the way of beta emitters coming down the Susquehanna River.
[Discussion]

BRIAN RESH: I am Brian Resh.
First off, I would like to express my total disdain for the condescension shown the public by GPU and the NRC.

And my very brief question concerns the $965 million projected cleanup cost, and exactly how much of that will be borne by the consumer, the rate payer or both?
I believe the spokesman from GPU has the answer to that.

ARTHUR MORRIS: Mr. Standerfer, could you respond to that?

FRANK STANDERFER: That portion -- that is the Thornburg Plan, and about $200 million is borne by the consumers in New Jersey and Pennsylvania. [Discussion]

BETTY TOMPKINS: Betty Tompkins. I would like to speak about the water of the City of Lancaster. I will speak now for the locked-in poor citizens of Lancaster City who drink that water and cannot afford bottled water.
I have in the past contacted Mr. Friedman about the water, and I had a statement mailed. I am not technically thinking right now, but what Doris said is absolutely right.
The City of Lancaster is not presently monitoring for these elements that we feel might be coming down from Three Mile Island. And so I ask you, as mayor of Lancaster, to look into that.

ARTHUR MORRIS: The City of Lancaster has equipment at the plant site that does -- we do run tests on a daily basis. And in addition to that, I don't know if Bill Kirk is here and can speak to the fact that there are tests run separately from the city on the water at the plant that we receive.

BILL KIRK: Bill Kirk. There is no good way to monitor beta on-line. There is a sample taken. As I recall, every hour or two there is a slug put into a jug and we get that weekly and analyze that, including tritium and strontium.
There is a continuous sample taken from the discharge at Three Mile Island. That is monitored on a daily basis, analyzed on a daily basis for tritium and on a weekly basis for strontium. And we are monitoring it at the source.

NIEL WALD: Isn't there also a requirement of the EPA under the Federal Clean Drinking Water Act that the drinking water of any public purveyor of water to the public be monitored for all alpha, beta, and gamma radiation?

BILL KIRK: Right. The clean drinking water standard for tritium is 20,000 pCi/1, which is very much higher than anything we ever deal with here.

ARTHUR MORRIS: I think what needs to be remembered is the test we run is a daily test with information available right away.
The tests that are run why EPA take a longer period of time than that. And we don't get those results for several weeks following the tests. We have not had a test that has shown positive, however, since the beginning of the problem in 1979.

BILL KIRK: I think there was one sample in eight years that bearly exceeded the detectable limit. And that was 350 or 400 pCi/l several years ago for one day.
Another other than that, it was below the detection limits in the order of 200 or 240 pCi/l.

THOMAS GERUSKY: Of tritium?

BILL KIRK: Yes

ARTHUR MORRIS: Again, the understanding when we received the equipment was we would have equipment that we could use with our own plant personnel on a daily basis that would give us a very quick verifiable feeling of an immediate problem.
That is what we are doing. We have a backup with EPA, but it takes a longer period of time to get that information, but it is checked.

FRANCES SKOLNICK: Is that for all three types of radiation?

BILL KIRK: The analysis includes a gross alpha and gross beta analysis, and specifically a tritium, and an aliquot is analyzed for strontium.
Basically we take a piece of each daily sample for a week and analyze the weekly sample for strontium.

FRANCES SKOLNICK: It is my understanding from different scientists that it is extremely important to understand that alpha radiation can only be picked up by extremely sophisticated alpha monitors.
I think what we are typing to point out tonight is, Do you look for gamma radiation with one type of monitor? Do you look for beta radiation with another type? And do you look for alpha radiation with another type of monitor?

BILL KIRK: Certainly. That is the only way to do it.

FRANCES SKOLNICK: Can you write down the names of the kind of monitors?

BILL KIRK: I will be happy to talk with you. I can give you generic answers. If we get down to speicfic instrument types, then we have to get the particular instrument that is being used.
I don't normally carry mark and mods in my head.

FRANCES SKOLNICK: And I would like to find the number of times during the month that each particular radiation type is looked for.

BILL KIRK: If you would look in the Long-Term Monitoring Plan, which has been published, there is a schedule of all the analyses which we do in that plan.
As far as the results are concerned, we have published the result of our tritium and air analyses. We have not specifically published the results of most of our water analyses, because they have been negative. There hasn't been anything to publish.

The State has published the gross alpha and gross beta and tritium readings from all of the samples in their yearly report, in their annual monitoring report. The alpha and beta and tritium numbers have been published to '85.

FRANCES SKOLNICK: When you said "nothing," do you mean zero or do you mean below the detection limits?

BILL KIRK: Below the detection limits. And we have given you the detection limits for the different types of analsyes, I believe in the monitoring plan. I know for gamma we have and for tritium.

ARTHUR MORRIS: Is it possible for you and Frances to talk about this either by telephone or after the meeting? Can you provide her with the information that she is requesting? Is that okay?

BILL KIRK: No problem.
[comments]

A SPEAKER: It is my understanding that at the end of '87 the EPA will be phasing out their monitoring; that that is the plan for concluding the cleanup.
My question is, if EPA will be leaving at the end of '87, who will be continuing to monitor, particularly if the waste water is dispersed in some way throughout the atmosphere or discharged in the river?

BILL KIRK: The long-term plan that we had proposed perhaps several months ago calls for some of these things to be taken over by the State of Pennsylvania, the Pennsylvania Department of Environmental Resources.
We had called for in that plan to find out certain types of monitoring when the fuel was canned up and ready to ship, and other types at the time it has been shipped.
I am sure you realize what happens in the Federal Government when budget time comes along. Everyone gets uncertain for another year. My guess on whether something that we have set forth as a plan this year will continue to be true two years from now is as good as yours.
I at one time would have sworn to it and other times I won't not swear to it. It depends on what state is of the budget process we are in. I have been wiped off the books five times in the last seven years, and we are still here.

A SPEAKER: So there is a possibility of future monitoring?

BILL KIRK: Beyond the shipping of the fuel, there are no plans for EPA to continue specifically monitoring here.
EPA does not have any legal mandate to monitor around operating reactors.
Once that cleanup has been finished, our role here is done.

FREDERICK RICE: Yes, Frank, in the evaporation process, am I correct in assuming that all the isotopes are removed during that process and fall into this solid?
[Discussion]

JOHN LEUTZELSCHWAB: On the list of isotopes there, do they, any of them, exceed MPC?
[Discussion]

THOMAS GERUSKY: On your carryover, can you go into more detail on what the carryover monitor does and how it does it?
[Discussion]
Then this really isn't a monitor as much as -- It's not a radiological monitor in the sense we think of it in nuclear power plants. You're monitoring just the total solids, I guess, in the water, in the water vapor.

CHARLES URLAND: Yes.

THOMAS GERUSKY: The next step is you're doing radiological monitoring behind that, it looks like. What are you going to be looking for?
[Discussion]
They have -- Is there any automatic control that will shut the facility down if a preset point is reached?
[Discussion]
What are you going to do the liquid -- the radioactivity analysis of the release? Are you going to take the samples from the two monitors or are you going to just take them in the evaporator itself?
[Discussion]
On your strontium 90 decontamination factor through the exchange system, you didn't really -- The strontium 90 concentrations vary considerably, and you came out with one number. It really didn't show what the decontamination factor was. Do you have that number?

FRANK STANDERFER: Let Ken --

KENNETH HOFSTETTER: Decontamination number, of course, does tend to vary with the concentration of input water. That is the effluent, quality of the effluent remains about the same. So, for instance, when we were processing water out of the reactor building basement which had high levels of radioactivity, the DFs, if you want to call them that, were quite high. When we look at water which has been recycled, that is, has been reused for decontamination, picked up small amounts of water, the DF will appropriately be lower because the influent concentrations are lower as a result. For the reactor building basement where we had cesium concentrations of 120 microcuries per milliliter, DF to the total system was on the order of eight orders of magnitude. For processing the reactor coolant system presently, for instance, the DF is more on the order of

four orders of magnitude because the concentrations of the influent are reduced accordingly.

THOMAS GERUSKY: Is that because of solubility, or shouldn't the decontamination factor remain constant no matter what you start out with, or is it -- I mean, particulate, I can see it being removable. What about the soluble fraction?
[Discussion]
I don't have any more.

ARTHUR MORRIS: Anybody else on the panel?

FREDERICK RICE: Frank, what is the time process of this mechanical process? Once it starts, is it continuous?
[Discussion]

JOEL ROTH: I'd like to backtrack to the automatic shutdown that Tom talked about and you talked about, Frank. Would you go into that in a little more detail? In other words, the scenario if something happens.
[Discussion]
What are the chances of that happening?
[Discussion]
How quickly?

FRANK STANDERFER: It's done in minutes.

JOEL ROTH: Now, how do you know then what has gone up or out at that point?

FRANK STANDERFER: You have taken samples. You can analyze those samples.

JOEL ROTH: But I'd like to backtrack again for more specificity to say what happens. Two minutes, something has gotten out that shouldn't have gotten out.
[Discussion]
Just one followup on that. If it does occur, is there a certain procedure that would be followed? In other words, I guess I'm trying to find out --
[Discussion]
Would that be made known to the public then?
Venting today, every day, right?

FRANK STANDERFER: Yes.

JOEL ROTH: So you'd have to look for it.
[Discussion]
Is that the new term, upsets?
[Discussion]

ARTHUR MORRIS: John?

JOHN LUETZELSCHWAB: The output of the stack, the 100 feet, what is going to happen to that in the various conditions of weather? Is it going to touch ground? Is that going to stay above?
[Discussion]
So you assume this stuff released under your dose calculations?
[Discussion]
What minimum height would you need? I look at the coal plant down the river, and I see that nice coal, and it stays nice and high and just leaves the area. That's the whole purpose of it. What minimum height would you need to get it so that people in this area won't have to breathe any effluent from that and send it someplace else?
[Discussion]
But it doesn't touch ground within 20 miles or anything like that.
[Discussion]

THOMAS GERUSKY: Just a followup on that. Are you considering the possibility of putting it out the plant stack?
[Discussion]
Since you brought up the vendor issue, are your specifications for the evaporator, do they vary with, in effect, decontamination factor or removal concentration, removal factors or the particulates?
[Discussion]
That's the question I had. We're getting at it. Are you going to purchase the one that has the best reduction or what is -- How are you going to pick the vendor?
[Discussion]
Are they all the same ball park for cost?
[Discussion]

KENNETH MILLER: I guess I don't understand. Now you're talking about tremendous differences in volumes of solid collected. And I would assumes if you're not collecting them, they are ending up going out in the environment in steam. What makes a big difference of about a factor of four or so there?
[Discussion]

FREDERICK RICE: Frank, have you had to develop a special monitoring system to adapt to this evaporation process?
[Discussion]

JOEL ROTH: Just a followup question on what John had asked about weather conditions. Are there any weather conditions that would prevent the evaporation process from continuing?
[Discussion]
So, in other words, you're saying there are no weather conditions that would stop it, is what you're saying?
[Discussion]
It just wouldn't be the evaporation process?
[Discussion]

KENNETH MILLER: I have a two-part question. First of all, I assume that the NRC has done their own independent evaluation. I'm curious as to what sort of results they got and how they compare with yours for the environmental impact. Secondly, I'm wondering what sort of errors are associated with the assumptions that have to be made to get this type of number.
[Discussion]
Are there any glaring discrepancies between their results and yours?
[Discussion]

THOMAS GERUSKY: There is a difference between changing conclusions and changing outside dose. Is that what you meant to say, that the outside dose --
[Discussion]
Your conclusions are that any of the systems --
[Discussion]

GORDON ROBINSON: Is there anything unique about this evaporator, or is it one that has been used in other applications?
[Discussion]
So basically my concern was each vendor has had previous experience?
[Discussion]

ANNE TRUNK: I'd like to know how often you are going to do the monitoring and who is going to do it. Is it GPU or the vendor?
[Discussion]
Is there going to be somebody checking it all the time, or do you just every hour or so check it?
[Discussion]

THOMAS GERUSKY: Are you planning on changing your environmental monitoring program at all?
[Discussion]

FRANCES SKOLNICK: My name is Frances Skolnick. Mr. Standerfer, I would like to know why the SVA didn't receive a letter which you sent to the NRC on February 3 and 18, because we do have a legal agreement that we receive all written correspondence between the NRC and GPU concerning the water disposal.
[Discussion]
I did not receive one. I would like a copy, please.
[Discussion]
I would like you to be aware, please, in the future, because it is imperative that we receive correspondence immediately.
[Discussion]
It is, because I looked into this matter before some months ago, before the issue was brought to the front again.
[Discussion]
I'd just like to make some clarification here. The water that is already purified, is that going to be used again in the cleanup or is that sitting on site waiting to be disposed of, in tanks?

[Discussion]
On the page where it says estimated average concentration of radio-nuclides, at some point are you going to monitor for each of these radio-nuclides or will you be continuing to be doing mathematical estimations?
[Discussion]
Will you be using alpha radiation monitors for the samples before they go into the evaporator?
[Discussion]
But will the radiochemical anaysis find all alpha-emitting particles?
[Discussion]
Do you have a number or something that we could receive which states the detectable limits?
[Discussion]
I think I have just one other question. It concerns the chemicals. I'm aware that probably the sodium borate is the largest quantity of chemical in the water. But do you have a list of the other chemicals of lesser quantities?
[Discussion]
Do you have a list of those chemicals that you look for and that have, in fact, been used in the reactor prior to the accident and since the accident and cleanup?
[Discussion]
Would the oils and greases be included in that? Would they be removed?
[Discussion]
I have just one other question. When water comes out of the SDS system and the epicor system, and has an equal amount of radionuclides been removed from each? In other words, when that water enters the tank from each of the other tanks, the epicor system and the SDS, are they exactly the same? Are we mixing lower level radioactive water with slightly higher level?
[Discussion]
Okay. Thank you very much.
[Discussion]

AL MANIX: Al Manix. On a given day like today with the system in operation and you are dispersing the water, how far will it travel?
[Discussion]
Do you have a feel for how far it will travel? I want to see whose doorsteps it's going to land on.
[Discussion]
Half a mile, a mile, ten miles, fifty miles?
[Discussion]
100 miles?
[Discussion]
You're telling me the system was used before. So apparently this shouldn't be no big problem then. On a day like today, give me a number. Don't give me a yes; give me a number.
[Discussion]
That's saying a lot.
[Discussion]

DICK BROWN: Yes, I'm Dick Brown, vice president of Lancaster Environmental Action Federation. I'm here representing LEAF. This is LEAF's statement on the evaporation problem.

The Lancaster Environmental Action Federation, better known as LEAF, has taken the following position on the Nuclear Regulatory Commission's proposal for the disposal of Three Mile Island waste water:

1. We believe the evaporation of the radioactive tritium waste water over Lancaster County is totally unacceptable.

2. A Nuclear Regulatory Commission decision on this problem is premature since the final quantity of contaminated water and the exact nature of the contaminants are not known.

3. This problem does not demand an immediate solution. Therefore, we recommend a more thorough study of this complex issue.

4. Costs must not dictate the final solution for disposal of these materials.

5. All decisions relative to the disposal of the various components of the TMI waste water must respect the integrity of the existing ecosystem and do nothing to endanger it.

Thank you.

JOEL ROTH: Will you be putting a copy of that in the record? I'd just like to ask a couple questions, Mr. Brown, if I may. Could you just give a very brief description of your organization to get a better understanding of who you're representing, you know, the numbers and area?

DICK BROWN: LEAF is an organization that has existed since 1972. We have a membership of something over 100. We have been involved in a variety of issues, including TMI, nuclear power back before TMI, farmland preservation and solid waste. Our main claim to fame probably is that we run recycling centers, and we have been involved in assisting the county with recycling over the past four or five years in a rather large way.

JOEL ROTH: Thank you. That's all.

THOMAS GERUSKY: I have a question. Do you have an alternative proposal then other than what has been looked at?

DICK BROWN: To answer your question, we are in a non-profit group of citizens, no staff. Basically, like many non-profit groups, environmental groups, trying to sort out the environmental dilemma, which is what we're in here. We met last night and we discussed this very issue. And we had a problem coming up with a solution, as everybody else is. The problem here is the same problem we have pretty much universally when it comes to pollution, and that is that man has taken material, scattered it through the environment in many places, and through this process has concentrated them to make its products, whether it's glass bottles or plastic bottles or neckties or clothing or whatever it is that we have. Almost all these things were at one time scattered. The uranium on Three Mile Island is an example of it. The environment is probably safe, in quotes. It's scattered so far that its effects aren't as great, but when you put in all in one place, you have a problem.

So we discussed this very issue. What do you do with something when you get a concentrate? The probably ultimate answer for this particular problem is to dilute it. You can't destroy it because it's water. My own opinion and, I think, that of the board that met last night is that the water should be evaporated in a position where it would go over the ocean, not over a populated area if it's going to be evaporated. It shouldn't be evaporated over any land area. It should be evaporated so that it goes over the ocean, probably in a colder climate where the water, when the tritium water did hit the ocean in a colder climate, say up northeast or perhaps in some other area closer to the ocean, would have less impact on the living creatures in the ocean because of the cold. At least that's what our biologists tell us. So I don't know whether that answers your question, but that was our dilemma. We discussed it, and dilution unfortunately is the way we do a lot of solving problems of pollution. And we believe it will be better to dilute it in the ocean or over the ocean than to do it over Lancaster County. That we feel strongly about.

JOEL ROTH: Okay, thank you. Well, if there are no further questions -- Oh, there is.

FRANK DAVIS: I'm Frank Davis, Mechanicsburg. I guess in answer to the question that Mr. Gerusky asked about alternatives, I think we need to go back to the assumptions on which this whole discussion is taking place, the need, the feeling of the people in the area that the waste should be removed so that it would be safer for the people here and safer for the workers. Now, I think that many of us have come to the position after studying the Environmental Impact Statement drawn up on this that the safest thing for the foreseeable future for both the people who live in this area and for the workers is to leave the contaminated water in the tanks where it is now and let it decay, rather than to subject the public and many workers to a great deal more contamination by evaporating it, by moving it around, by burying it and so on. And with proper care, I think that both the public and workers would receive less contamination, less exposure, if the water were allowed to decay in its present condition.
[Discussion, Recess, and NRC presentation]

ARTHUR MORRIS: Bill, just looking -- And I was out of the room when this statement was read from LEAF, Lancaster Environmental Action Federation. Their second point, I think, says that a Nuclear Regulatory Commission decision on this problem is premature since the final quantity of contaminated water and the exact nature of the contaminants are not known. How would you react to that comment, if you would?
[Discussion]
How about on the -- You have answered two of those parts. The one is on the quantity of contaminated water. We've been given a presentation on that today that total volume of water is expected to be somewhere between 2 and 2.3 million, and the variants of the 300,000 gallons has to do, we're told by GPU, depends upon the additional water needed between now and October, 1988. Your reaction to how good of numbers you feel they are.

[Discussion]

JOEL ROTH: Bill, I'm just going to try to put something in -- I'm trying to understand the logic here. The initial premise for the disposal of the water now and always has been that the Island should not be a low waste storage site. Then to jump in my mind to the monitored storage aspect of the end point, you know, of cleanup, where they are going to be monitoring allegedly some low-level waste that is going to be allowed to remain on the Island, is that correct?

WILLIAM TRAVERS: That's the proposal.

JOEL ROTH: That's their proposal. Are you saying then that it might not be, in fact, true that there will not be allowed to be any low-level waste remaining on the Island?
[Discussion]
I guess the reason I'm questioning this is because it's always seemed to be the anchor of the NRC's stand that the water had to go and other things had to go. And yet I'm getting a sense from the public in a very strong way, probably the strongest in a number of years, and what I'm hearing here is the fact that the public is saying, well, they'd really rather have it stay, you know, in the tanks for the time being. And I'm wondering if you had to rate on, say, one to five the damage or the health effects or something of that nature of allowing that water to say versus allowing whatever low-level waste is allowed to stay, which, in your opinion, would be the lesser of the damage, potential damage, if you follow. I'm trying to compare with using your basic premise which we have heard for seven years, that low-level waste has to go.
[Discussion]
What I'm trying at this point in my mind to understand, since we're probably going to have to vote on this and try to come up with some type of an idea on what to do and, in my mind, try to convey to the public or to myself what I'm hearing, and it's just the logic of it, I think, at this point is escaping me in that the interim monitored storage or the monitored storage routine seems to be almost a given, that something is going to be there. That may be all right. You know, I realize I'm jumping a little bit into that. But I'm just trying to get a sense of why can it not stay for the time being.
[Discussion]
Yes. Just one further point, if I may. I looked at the clock, and we still have time.

ARTHUR MORRIS: We have plenty of time.

JOEL ROTH: Is the fact - and I'm trying to phrase it so that we can understand - is with the public -- I'm not saying that some of them are not even saying that yes, maybe environmentally, I think again it goes to the emotion and the psychology of it, of just not wishing to be, quote, as I've read in some of these statements, be dumped upon or evaporated upon. And I think over the years that the psychological or the emotional

impact has and should be evaluated. So in that context, I wonder if you have --
[Discussion]

ARTHUR MORRIS: That's part of the problem we're facing now, is it's that water, and I think I understand what you're saying, that it's always going to be categorized as that water from the accident, whether it's a day or ten years from now or twenty years from now. And I'd like to -- If you would choose the option, if the option would be chosen to store the water on the Island, my assumption is that it would not be done in the fashion or the exact specific tankages that it's stored in today, that it would have to be -- Maybe some of the processed water stored in tanks 1 and 2 would remain. But some of the other facilities that are there that contain the water, I'm assuming, maybe wrongly, that you would empty the water out of those locations, and you would have to build additional tankage. Or has that been looked at at all or is it your assumption that it would stay exactly where it is now?
[Discussion]
I had thought that one of the concerns they had some time ago was in the capacity of the tankage and that there may be a time when they may run into a capacity problem and need to build additional tanks.
[Discussion]
I'd like, Frank, to have somebody speak to it. I really automatically assumed that they would not want to leave it in some of the locations that it is presently in, and they wouldn't want to put it in a totally contained --
[Discussion]
I clearly understand that. I'm not, as I ask questions, proposing that. I'm trying to understand that option, that should it be taken, would require additional tankage.

FRANK STANDERFER: Yes.

ARTHUR MORRIS: You're saying you have how much capacity? 1.6 million?

FRANK STANDERFER: I believe it's about 1.5, but I don't have that good number.

ARTHUR MORRIS: I realize and I would indicate your numbers for the record were just estimates and just getting a sense of it. Is that 1.5 or 1.6 capacity usable for the future storage or is it something that if you would go five years down the line, you would think we would start having a problem with seals or some other things, that we better build?

FRANK STANDERFER: No. It would be usable for some indefinite period of time. The tanks are good quality tanks.

ARTHUR MORRIS: So then you would need about 700,000 gallons maybe of additional tankage. The tankage at that point that would be on the Island lifetime, I mean, you're looking at not a problem for ten, twenty, thirty years or something like that.

[Discussion]

ARTHUR MORRIS: We have water storage tanks. I don't even know if that's comparable, but obviously they last for considerably ten to twenty years if properly maintained.
[Discussion]
Just again, I just want to -- I'm trying to get a feeling for how much more tankage. How long would that last before it would need to be replaced and then try to correlate that with the half-life of -- How much have you really gained by waiting that long in half-life?
[Discussion]
You're saying that if you wait that long a period of time, the potential is that you start running into tankage problems and you'll need some replacements? Is that what I hear?
[Discussion]

ELIZABETH MARSHALL: Yes. I was wondering if there was any possibility of the tanks themselves, and I mean over a long period of time, absorbing radioactivity and becoming radioactive.

WILLIAM TRAVERS: No. They are stainless steel tanks. They wouldn't absorb the radioactive material contained in the water.

ELIZABETH MARSHALL: They would not?
[Discussion]

ARTHUR MORRIS: Is that the same as would have to happen with the remaining section of the plant, that the radioactivity would have to then be totally removed?
[Discussion]

KAY PICKERINE: Kay Pickerine (phonetic). I have several questions directed maybe to the NRC and EPA. I have not heard from either organization comments on how this process would be monitored. I heard GPU talking about the option of probably or possibly considering the installation of tritium air monitors. That just raises in my mind all the questions about the license, what options does GPU have when they are asking for this change in their license. What are the regulations with regard to the involvement of the NRC and EPA? The community hasn't really had a chance to discuss that kind of interaction with regard to the on-site actual monitoring. Tonight I really understand for the first time the process that a vendor would come in, building the system and then be responsible for the actual working of the system. That was all fuzzy in my mind until I got here tonight and heard that discussion. That just raised all those fears and all that psychological problem of again another entity coming in, GPU overseeing another contractor on site, doing work. Does the NRC then oversee GPU, and what are the regulations with regard to on-site and off-site monitoring of -- and DER, too. I mean, we have three entities who in some way monitor on site and off site the radiation factors monitoring.
[Discussion]

ARTHUR MORRIS: The monitoring that will be done on the evaporation itself is part of the equipment to be provided by the contractor?
[Discussion]
Any action that is taken as a result of the monitoring system in terms of a problem I assume would be the action -- the action would be taken by the contractor who is under some kind of overview by the -- by GPU. Is that what you would envision? Or should we be asking Frank? I'm just trying to bring out a little bit more of the question that was raised on what is the sequence of events that would normally take place.
[Discussion]

DICK BROWN: Dick Brown from LEAF. I have a question and a concern relative to what we were just talking about. One factor that hasn't even been mentioned is that TMI-1 at some point in this scenario will have to be decommissioned. And there will also be waste water from that facility which will have to be disposed of in a similar manner because there's going to be within -- This is a process that's going to have to take place in the future. And if I'm following the scenario correctly, they aren't going to do anything with the water until after they are done with the cleanup, which is at least the end of next year, perhaps even 1988, or end of this year. Then it's going to take two and a half years to evaporate the water. We're already into 1990. When did TMI begin, unit one? What was the year it started, was licensed?

FRANK STANDERFER: 1974.

DICK BROWN: They operated for five years. Now it's operated almost another one. So its life span may be only twenty years, 25 years. So by the year 2000, we may be talking about additional problems which may be - I'm just suggesting - maybe the water problem has to be addressed in the light of -- at that point, what's going to happen to the water at TMI-1 as it goes through decommissioning process at some foreseeable point in the future.
[Discussion]

ARTHUR MORRIS: So the TMI-1 water, whatever would happen in the end, would probably be, unless it's something very unusual, would be probably discharged. Is that what you're going to end up saying?

WILLIAM TRAVERS: It is being discharged.

ARTHUR MORRIS: It is now, and any water that would end up at that site would probably --

WILLIAM TRAVERS: Unless some unusual circumstance arose.

KENNETH MILLER: I guess I'm addressing this comment or question to Mrs. Munson. Back I guess in 1981 when the first Draft Environmental Impact Statement came out, I took a look at the tritium numbers and did some quick calculations of average Susquehanna River flow. And I don't recall the exact numbers, but it seemed that the amount of radioactivity

we're talking about in this water flows by TMI every 150 days or so. I would guess if we look at Lancaster County and if we look at Dauphin County, we would find the rainfalls bringing this amount of radioactivity down in these counties with every so many inches of rainfall and so on. And I think that type of information may be very useful in explaining what we're talking about here in terms of radioactivity concentrations and what that means when it's put out into the environment. What we're talking about here, I think, is comparable to what is there already.
[Discussion]

ARTHUR MORRIS: Do you have a way of summarizing that fairly quickly? It does talk about it, but is there anything special you want to indicate that it says?
[Discussion]

KENNETH MILLER: So we're really talking here about total levels of tritium that if we could condense it down into a small volume, we could put it in about 2,000 watches and give it to people walking out of the plant to wear forever. When they are through wearing them or they stop working, they could chuck them out in any landfill?
[Discussion; Dinner Recess]

ERIC EPSTEIN: For the record, Eric Epstein, spokesperson for TMI Alert.
I know for Gordon, the first thing I wanted to clarify with you, I said I would have some names from some folks better known as scientists or technical experts. After discussing it with some other environmentalists and other members of my group, I have decided not to do that for a number of reasons that I would like to explain. First of all, I didn't think the NRC would fund their research. Secondly, I am very wary about handing over names of organizations to anybody, Gordon. So what we have done, and Frances will speak to it later, we have submitted the EIS and talked with various experts throughout the country, and hopefully we will be able to produce either testimony or an expert at the next meeting, and I know that was one point that you had pursued with me. I wanted to give you my reasoning for not preparing a blanket list of individuals or organizations. I didn't feel comfortable with it when I talked it over with other folks. If that's okay with you, I will continue.

GORDON ROBINSON: Yes, that's your choice.

ERIC EPSTEIN: If has just been after thinking, my experience with the NRC over the last seven years had a great impact on that decision.
What I am going to do now, Mayor Morris, is turn the speaker over to Vera Stuchinski, who is going to make comment for us this evening. After everybody else speaks, I'd like to get on the agenda, if I could, to address some of the questions I had for the NRC. She is going to make the official comments for TMI here this evening. So at this time I would like to turn the mike over to her.
[Discussion]

VERA STUCHINSKI: My name is Vera Stuchinski. I am sorry Eric and I were not able to be here earlier in the day. I decided to give him a break, as chairperson, and make the presentation tonight.

I have TMIA's comments to the panel on the NRC's revised EIS on the disposal of the water, and I'd like to present this as a matter of public record.

I appreciate the Panel's concern about the insufficient information provided to the public in the NRC's revised Environmental Impact Statement, and your determination to gather additional information before meeting with the Commissioners. As a representative of the citizens' safe energy group, Three Mile Island Alert, I would like to bring to the Panel's attention, the need for further assessment of the health effects of tritium.

First, let me preface my remarks with the fact that on Friday, February 20, General Public Utilities issued a statement saying that the Department of Energy has granted the utility an additional 46,000 cubic feet of disposal space at a commercial low-level nuclear waste site. The allocation is needed to dispose of radioactive residue from a proposed evaporation process. The Harrisburg Patriot News noted that the approval is a "significant step" for the utility in their proposal to evaporate the 2.1 million gallons of contaminated water.

It appears that evaporation is leading as the method of choice of both the utility and the DOE. We have been assured that dispersal of 1020 curies of tritium over a two or three year period will be inconsequential since tritium is to be found in the environment from reactor fuel, weapons testing, manufacturing and natural occurrence. It is noted in the revised EIS, that the tritium concentration of the Susquehanna River was measured during 1977 and found to be fairly constant at 178 pCi/L. The NRC's data on tritium concentration in the Susquehanna River, though, is based on information that was collected ten years ago. We feel this is but another superficial and inadequate investigation by the NRC. We would like to know the current concentration of tritium in the Susquehanna. The EIS should be revised to include data in order to be accurate and accountable.

At the Advisory Panel meeting on January 21, 1987, TMI Alert and other individuals stressed to the Panel that we want no additional environmental releases of radiation from the cleanup. I cannot stress this point enough. We are concerned with the cumulative effects of years of radiation exposure.

On page 2.6 of the EIS, under the section entitled, "Interactions of Tritium with Biological Systems," the report states that when humans are exposed to tritium as tritiated water by inhalation, ingestion or skin adsorption, the majority of the isotope is eliminated from the body with about a 10-day biological half-life. A small fraction of the intake, usually less than a few percent, is eliminated with a biological half-life of about 30 days, and even a smaller fraction with a biological half-life of about 450 days.

According to this report, it sounds as though the tritium is almost immediately eliminated from the body. But in order to calculate the hazardous life of the substance, one must multiply by ten. Therefore, the majority of the isotope is eliminated from the body with about a

100 day hazardous life. A small fraction of the intake is eliminated with a hazardous life of about 300 days, and a smaller fraction with a hazardous life of about 4,500 days, which is about 12-13 years.

We do not know the long-term health effects of tritium, nor does GPU or the NRC. More empty assurances of safe levels are not what we need. I would like to call your attention to the report released in October, 1986, by Congressman Edward J. Markey, who is Chairman of the House Subcommittee on Energy Conservation and Power. It is entitled, "American Guinea Pigs: Three Decades of Radiation Experiments on U.S. Citizens." It describes in detail, experiments conducted by the Manhattan Project and the Atomic Energy Commission, from the mid-40's to the early 70's as supplied by DOE documents, and it was to measure the effects of radiation on humans. Markey urged the DOE to make every practicable effort to identify the subjects and to examine their long-term health histories to determine long-term health effects.

According to the report, from 1950 to 1952, human subjects were exposed to tritium in several different experiments: exposure to tritiated water and water vapor, inhalation of tritium-saturated oxygen, and the ingestion of tritiated water. The objective of the experiments was to obtain information on the absorption and retention of tritium. But, following the experiments, the DOE reports no medical follow up of the subjects. Obviously, here is a population if studied, that could yield invaluable information on health effects of exposure to tritium. As usual, GPU and the NRC are willing to proceed before the necessary factors have all been collected.

Another major consideration that has been ignored, as usual, is the impact of stress on citizens living in the surrounding communities. The contaminated water has not yet been tested for transuranics. As of the last meeting, the information was very sketchy. We feel this is essential. We have heard no statements from the NRC, EPA or DER concerning additional monitoring of the actual procedure, as well as any emissions that would be released. With GPU's long track record of misconduct and disregard for health and safety, we regard the additional monitoring by government agencies to be necessary for public accountability.

I must emphasize that we do not trust the utility. GPU must not be given the go-ahead to evaporate the 2.1 million gallons of contaminated water before the facts are in. I must also re-emphasize to you our position that the decision on what to do with the water must not be made in haste. GPU would like to dispose of the water quickly, so that they can finish the cleanup. Isn't it rather ironically amusing that in order to clean up the waste, the utility would propose contaminating the environment? That's our official statement from TMI Alert.

ARTHUR MORRIS: Ken?

KENNETH MILLER: I want to say I don't agree with everything you have said, but I don't really want to go through it point by point. What I would like to ask you is: What is your alternative? What method of handling this material are you proposing?

VERA STUCHINSKI: I don't feel we can endorse any of the methods. Again, I feel we are being asked to make a decision when the study is not complete. I would go back in time several years ago when we talked about at the last meeting krypton venting. We found about two or three years after the krypton venting an expert, Micho Kaku, from Columbia University or New York University?

ERIC EPSTEIN: CCNY

VERA STUCHINSKI: Talked to us about that there are alternative methods for dealing with the krypton gas. For example, perhaps, there are alternative methods for dealing with the water. I feel that we are being pushed to rush into a let's finish it up, and I do not feel that everything has been covered, everything has been studied enough.

ERIC EPSTEIN: I know, Dr. Miller, that you do not agree with many of the points made. I mean that is nothing new to me. I would like to say a few things. I don't think anybody would really have a problem with the materials being shipped to Hanford, the reservation in Washington, or to the Nevada test site. To be quite honest with you, I think that is probably a resolution that would be acceptable to a lot of folks.
I'd like to say also I just met with the NRC for four hours on Tuesday discussing activities at Unit 1 and also met with the NRC previously for three hours at Unit 2. It is quite apparent that Unit 2 with its fuel pools is an ideal place for the waste of high level and low level from Unit 1 and also Oyster Creek. It is apparent to me that we are rushing through this process to make room, and there is nothing in the license currently at Three Mile Island to prevent Unit 2 from storing high level or low level waste on site with the waste pools, and that is the feeling I have. I'm quite sure that will be born out in the near future.
I see, Tom, you are shaking your head.

THOMAS GERUSKY: Not true.

ERIC EPSTEIN: This is true talking with both the NRC, Region 1.

THOMAS GERUSKY: I'm sorry. Their license has to authorize them to receive material from outside that plant. They are not authorized to do that.

ERIC EPSTEIN: Well, there seems to be some disagreement with the NRC whether waste from Oyster Creek could be shipped on, but there seems to be consensus that from TMI Unit 1 there would be no problem using Unit 2 as a storage facility.

THOMAS GERUSKY: Oh, sure there is. Right now they are separated completely. They can't be used, and it is their license amendment. Again you can't do that, I'm sorry.

ERIC EPSTEIN: I think there is a big difference of opinion on that issue. I don't know if I want to pursue it at the advisory panel, but I don't

think folks at Region 1 agree with you at all. I would hope you are right.

THOMAS GERUSKY: Well, if Region 1 doesn't agree with me, they are not going to operate the plant. I mean let's face it, they can't do that.

ERIC EPSTEIN: I hope you are right.
I don't know if that speaks to your question, but I wanted to preface my comments with that statement.
[Discussion and Dinner Break]

FRANCES SKOLNICK: Good evening, members of the panel. First of all, I want to start off in a lighter note.

ARTHUR MORRIS: Frances Skolnick, I'm sorry.

FRANCES SKOLNICK: When I was eating dinner tonight, I did have a fortune cookie, and the note on the fortune cookie was: "Your hard work will pay off soon."
I speak this evening for the membership of the Susquehanna Valley Alliance, a safe energy organization whose membership is mostly based in Lancaster County. The reasons we are so concerned about this radioactive water is because we stand to be impacted upon if GPU Nuclear either dumps it into the Susquehanna, our drinking water source, or evaporates it into the air.
Since we live downstream from the plant and we will therefore get the full impact of fallout, I am speaking at this public meeting this evening in order to convey our message loud and clear. Our message is this: As a community, we intend to stand up for our rights to clean air and clean water, and we feel that GPU Nuclear and the NRC are violating these rights.
We are really pleased that this panel is carefully considering the options presented to them. We are entirely sickened by the Nuclear Regulatory Commission and GPU Nuclear making statements about the safety of this water.
They have yet to learn that we are thinking, rational individuals, aware of our rights and able to discern deception from truth. Who do they think they are, telling us that they have three million gallons of radioactive water, which we are going to have to either breathe in or drink? Sorry, gentlemen, we will not allow you to do this to us.
If I may refer to the statement made by the lady from the NRC about tritium in exit signs and watches, I have to say we are not drinking or breathing the exit signs or the watches.
The documents which come from the NRC or GPU are shrouded in double talk, misinformation and a general lack of regard for the public. Their attitude is the show must go on at all costs.
Since the accident at TMI and particularly since the restart decision of Unit 1, it has become more and more apparent that we no longer have a regulatory body or even the pretense of one, but rather we have a promoter of nuclear power in the form of the Nuclear Regulatory Commission.

This past year or so, we have all become increasingly aware of the fact that nothing has been done to store in a safe manner the abundant radioactive waste that the nuclear industry is creating. All of us are victims of this travesty, and I am afraid it is exacting this lack of waste policy and the fact that GPU Nuclear wants to incur as little cost as possible that is making these gentlemen sweet talk us into breathing or drinking this radioactive water.

This radioactive water is really not our problem. GPU created it. Therefore, why are we being asked to carry it around in our bodies? It is as if we are being asked to be waste storage sites.

Tritiated water can be ingested in liquid form. It can also be inhaled or absorbed through the skin in the form of water vapor or steam, and pregnant females, tritium ingested by the mother can cross the placenta and be incorporated directly into the fetus. Like all radioactive substances, tritium can cause cancer, genetic mutations or developmental effects. No threshold or safe dose of tritium has been scientifically established for any of these effects.

By either dumping the water into the river or evaporation into the atmosphere, all the tritium will be released into the environment. We are extremely concerned of the exact nature of this water, and feel that the list of contents by GPU Nuclear and the NRC is inadequate for both radionuclides and chemicals. Even if the water contains only those items listed, the water still remains radioactive. To say it is almost pure is nonsense, and further threatens the credibility of the Nuclear Regulatory Commission and GPU Nuclear.

The tritium alone is a major source of concern. The radiological significance of tritium is not related to its inherent toxicity, it is a very low energy form of radiation, but to its easy incorporation into all parts of the body that contain water.

Dumping or evaporation are therefore not true methods of disposal, which implies that we are getting rid of it all. But, rather they are methods of dispersal, which means GPU Nuclear would be spreading the radioactivity in different directions.

On Page 3.3 of the updates in the environmental impact statement, the NRC states and I quote: "Although most vendor supplied transportable evaporator systems are designed to operate in a closed cycle mode, modifications would be made to the evaporator to allow it to operate in an open cycle mode that would permit a vapor to be discharged into the atmosphere."

I have to ask: Why modify the evaporator at all? Let it operate as it was built to operate and contain the radioactivity.

I also must comment on the NRC comments that discharge would be monitored to verify radioactive releases. I am concerned about who would read the monitors. Furthermore, I am convinced that some members of the NRC and GPU Nuclear equate monitoring with prevention of radioactive releases. It is important to clarify that what is being measured has already been released into our environment and the damage has been done.

We firmly believe that it is imperative to contain all radioactivity which is manmade. The question of how dangerous is radioactivity to our health is very much a debatable question, and as long as it is, let us

all, whether we are pro or anti nuclear, act responsibly and with caution when determining releases into our environment.
We believe also that it is imperative that technology is made available to contain the radioactivity of this water. We believe it is available, but cost considerations cause the Nuclear Regulatory Commission and GPU Nuclear to disregard it. I believe the NRC and GPU Nuclear are pushing us into making -- to taking a position and making a choice between evaporation or dumping, when really we do have more choices open to us.
I firmly urge the members of this panel, the NRC and GPU Nuclear to reject evaporation and dumping and to consider only those options favorable to the health and environment of this community. I am hopeful this panel will give the public permission to bring in additional experts to speak to the panel and that tonight we can arrange a date for the meeting
[Discussion]
Could you also clarify for us exactly how the panel will make their decision and what kind of decision -- I mean the procedure for you making your decisions about the --
[Discussion]

JOYCE CORRADI: My name is Joyce Corradi, C-o-r-r-a-d-i. I am with Concerned Mothers and Women.
Because of scheduling, I could not get to the meeting until the last half hour, so I do not know what happened previously nor will I waste my time or yours, I will find out after this meeting.
The one thing that Concerned Mothers and Women are very concerned about and would like to reiterate is what other groups and other individuals have said, that it is very important that you look at all alternatives, that you are not pushed into doing something because it is a quick fix. We have lived with quick fixes too long and the repercussions of them will be on us for many years to come.
I do have another question that concerns me very much about TMI 2 and information that was in the paper today concerning radioactive material that left the island via truck, and in the paper, Mr. Toom [phonetic] was contacted, and I would like some information on that, as to what happened and why it left the island.
[Discussion]
What I would like to know is what they violated in doing this what are the NRC's procedures for the handling of this material?
[Discussion]
I'd like to know what the NRC thinks about the incident.
[Discussion]

ERNEST GUILL: My name is Ernest Guill. I don't know if this relates to what you are doing, but has there been any study concerning the number of cancer cases and cancer deaths around TMI? Does anyone know, since the accident and following?
[Discussion]
Is there any governmental, local governmental monitoring unit or any local government, could they monitor the radiation from this evaporation or from the dumping?

ARTHUR MORRIS: There is a whole host of monitors that are in place now around the site.

ERNEST GUILL: Who are they run by, excuse me?
[Discussion]
I want to know who is monitoring the equipment?
[Discussion]
I had it answered earlier, but what I was wondering was: Is there any way an independent monitoring group could check the radiation that is being released, or as I said, the local governmental body from the city of Harrisburg --
[Discussion]
I think I was trying to address the level of stress that people talked about that people around the plant had, but if some group like GPU is doing it or the EPA, a lot of times the people wouldn't know who the people are involved doing the monitoring. If it is some local government agency, they will at least know who the person is that is doing the monitoring, perhaps feel safer. That's my opinion.

ARTHUR MORRIS: If you mean the local government agencies, there is none that I know of that are doing that or plan to do it, and you would have to take it to the individual government agencies that are adjacent to it.

ERNEST GUILL: Lancaster doesn't do it?

ARTHUR MORRIS: We are not doing it, that I know of, for tritium and the type of particles we are talking about coming out of TMI, no.
We will go to you second.

BEVERLY DAVIS: Beverly Davis.
I think it is obvious from everything that people are saying tonight and other times that the only reason this meeting is held and the only reason this study is done is because there is a feeling among people in this area that they want to be protected and they do not want to have the water treated as any -- would be treated from any ordinary plant. This means that frankly this is a political decision. It has very little to do with science or anything else.
The unusual thing about this is this is a decision, a political decision being based on the fact that the people are objecting to having this water given to them, yet the decision is being made, the answer to the problem is to disperse it to them so they breath it, take it in their bodies and have to live with it. I don't understand why you would solve that kind of political problem with that kind of political decision.
The main thing I think needs to be realized is this is not disposal. There is no such thing as disposal. All we do, we live in a closed system. We move it from one form to another or from one place to another. To move it from the place where it is where it is contained to people's bodies who have already been through the accident, who have already been contaminated by whatever we have been getting for the past eight years, does not make any sense, and I would hope that the people who are making the political decision would make it on keeping those

things in mind and not feel that the scientific part of it is the main part. The main part of this is a political decision. It requires a political answer, and that is what is best for the people in this area.
Oh, one more thing: Following up on what Joel said, to say this is being based on the fact that the NRC has made the decision not to put low level waste on this island is a very -- is facetious. They have already made the decision that they are not going to dismantle that plant and move it out of here. Whether they say they have or not, it is not going to be practical for them to do that, and I don't think that decision is going to be made down the line.
So worrying about what you are saying six milligrams of radioactivity for some water, and you are worrying about whether or not to change your decision to put radioactive waste on that island doesn't make any sense when in the larger sense you have already made the decision to have fuel rods on the island. For many, many years you have made the decision to have concrete which is contaminated, the steel which is contaminated. You have elements that are going to be radioactive for billions of years, as you are saying tonight. So it doesn't make sense to say that that is the only reason that that decision is being made, because the NRC has decided that that should not become a radioactive waste dump. We certainly concur, it shouldn't be, but that is not really the issue. We aren't even talking about that anymore, because that decision was already made.

ARTHUR MORRIS: Thank you.

DEBRA DAVENPORT: Debra Davenport for the Concerned Mothers and Women.
I also want to speak on the potentially hazardous waste dump that we might get on Three Mile Island. For the last several months, there have been in the weekly status reports for Unit 2 the on-going evaluation or an indication that there is an evaluation going on in a solid waste facility. There is already an interim waste facility. If we are not going to have one, then somebody had better apprise us otherwise.
I feel -- although I know I was informed when I called or asked about this, that there indeed was such a facility in progress, that it would be for waste for Unit 1 and from Unit 2. What I would like to ask at this point is that I be given a copy of the evaluation, then we can decide whether or not there is going to be a waste facility on that island.
[Discussion]

ARTHUR MORRIS: Please, Bill, if you would.

WILLIAM TRAVERS: I think what you are referring to is an evaluation we have on going relative to what is called the waste handling and packaging facility, which is a staging facility for the handling and packaging prior to shipment of radioactive waste associated with the cleanup, so it is not in any way, shape or form the storage or disposal of waste on the site that we are looking at and evaluating. Any evaluations that we have completed or will complete are publicly available and would be glad, more than happy to get you a copy.

DEBRA DAVENPORT: I would appreciate it. Are there any other evaluations for waste sites at this point?

WILLIAM TRAVERS: Waste sites?

DEBRA DAVENPORT: Well, waste storage facilities.

WILLIAM TRAVERS: Not that I'm aware of. If there are, we will get ou those, too.

DEBRA DAVENPORT: Because, I would like to say this, should this come up: I as totally opposed to putting anything like that on an island in the river. This makes no sense, floods. We were fearful in the beginning in this area. I think many people were fearful that the island would become a waste site, which it has, but to add to that problem is very, very careless. I feel all it does is save money and it wastes the lives of citizens in the area.
The only other thing I wanted to say was that I am still opposed to river dumping, and I am still opposed to putting this into the air. It seems to me to make sense to take this out to Nevada.

ARTHUR MORRIS: How do you feel about leaving it on the island?

DEBRA DAVENPORT: I don't think that would be safe. I can't be sure what they would do with the water, and also in other words, an emergency might come up. It might have to be disposed of, or it might have to be used in another way, and there is no way you can store it indefinitely or possibly not even for 20 years.
[Discussion]

JOHN ADAMS: John Adams, Susquehanna Valley Alliance.
I was told at the last meeting, there was some discussion about a distillation process that would remove the tritium from the water. Is there anyone that could comment about that?

ARTHUR MORRIS: I am not aware of that type of technique, but I think we were told that really wasn't possible, but if there is somebody else that can comment, please do so.
The whole premise of evaporation and the problem with disposing of the water is taking the tritium out of the water. But, there is no process really to do that.

JOHN ADAMS: So distillation is not a viable process?

ARTHUR MORRIS: The answer to that is: It is not a viable process, that's right.

JOHN ADAMS: Another comment, I would like --

ARTHUR MORRIS: Just to complete, I think we would love for it to be a viable operation, but it is not.

JOHN ADAMS: Fine. I wasn't clear about that information.
Another comment that I would like to make is that throughout the history of the nuclear policies and development of technology, these acceptable levels of radioactive exposure to the environment into human beings has been changing and has been dropping, and I think it is evident in the fact that x-rays are no longer routine for pregnant mothers, as they once were. We no longer have the type of devices in shoe stores where you can look down and see the bones in your feet. These have all been determined unsafe, and I think we might want to project our thoughts perhaps to some time into the future when we could look back at what is considered acceptable now, which will not be or may very well not be acceptable then and to say that the amounts of tritium are insignificant or acceptable is not a wise choice or decision to make. I think that those in the panel should take that into consideration, that these acceptable levels do change, and generally, they change for a lower acceptable level and not a safe level at all. Those are my comments.
[Discussion]

RONALD DAVIS: My name is Ronald Davis. I live in Millersville.
Recently, I had an educational experience which I wish I hadn't had, but I watched my father die of cancer, and prior to that, this issue of cancer and exposure to radioactive waste had been kind of an intellectual issue to me. But, I saw a man with tumors in his brain, in his lungs, in his spine, undergoing epileptic seizures, spending the last weeks of his life in intense pain, and finally at the end, being forced to choose between nourishment or morphine and being given morphine.
I was here, my family was here, for the accident in '79. We were here for the krypton venting, and really, you know, I have had enough. I get my water from the Susquehanna River. I don't want to drink the waste from Three Mile Island. I don't want to inhale the waste from Three Mile Island, and I think the attitude that you have to protect us against is one that well, they took the accident, they took the krypton venting, they have taken everything for eight years, they'll take a little more. I think really you are bound to stop us taking any more, and I really don't want to turn on my tap and be drinking tritiated water from Three Mile Island, so I think the bottom line has to be that the plant has to be cleaned up. We know that, but the releases to the environment do not have to go on. That is undoubtedly the cheapest way to do it, but it is also the cheapest way to do it in a morale sense, too.
So, you know, I really hadn't intended on speaking when I came here, but I just listened to the comments and evaluated my recent experience. I think it is incontrovertible that exposure to radioactivity does cause cancer in human beings, and I have been through these EIS's before, and there will be three thousandth's of a cancer death, and it will be buried in the population, so we will never know who did it. But, I have seen a cancer death, and it is a horrible thing. I think that even one, one more, whether it's a worker or someone living in Middletown, or someone living in Lancaster drinking the water is one too many. I guess my final comment is I have had enough. I have had enough exposure to radiation already, and I don't want any more. Thank you.
[Discussion]

ERIC EPSTEIN: Eric Epstein, TMI Alert.
Well, perhaps Bill should come up here, because I have compiled 22 questions and never received a formal response, not that I hold that against Bill, but I gleened through the questions and picked out five, which I think he can probably handle, if that is okay with Bill, because I will probably have him parading back and forth anyway.
[Discussion]
Question 21 which I listed and I'm worried about is: Is there an end point to this process? Does this process end precisely at 2.1 million gallons of water? If so, what happens to additional water? I am unclear as to the end point of all this. Is there exactly 2.1 million gallons of clean water segmented off somewhere? What happens to any other water generated as a result of this process?
[Discussion]
That water will be treated as any of the previous water, either evaporated or dumped, if that is the process deemed acceptable?
[Discussion]
Two questions to follow up on this: It would seem to me, what I am concerned with, it would be rather inviting for any other water on the island to be disposed of, either evaporated or dumped, once this precedent is established. What I am concerned about is what mechanism is in place to prevent any additional water or any of the highly radioactive water from being evaporated or dumped at the time? Who is going to make sure that doesn't happen?
[Discussion]
So if I understand you, Bill, then it is possible that what you are saying is the utility would be regulating itself, not to add any more water either highly radioactive or no radioactive water during the evaporation or dumping process. They will be their own police force?
[Discussion]
By physical presence?

WILLIAM TRAVERS: Correct.

ERIC EPSTEIN: Just three more questions. I don't know how I am doing, Mayor Morris, timewise.

ARTHUR MORRIS: You are doing fine.

ERIC EPSTEIN: I guess it is Page 3.12 and Page 3.10, the second paragraph. I was a little shocked to learn --

WILLIAM TRAVERS: Which question?

ERIC EPSTEIN: Question 8. Would the NRC allow GPU to place concreted waste in a trench on site?
[Discussion]
So if I interpret what you are saying correctly, there is a possibility that concreted waste could be buried on site?

WILLIAM TRAVERS: That's right.

ERIC EPSTEIN: I don't understand what delineates that from being a low level waste site.
[Discussion]
Moving to Question 7, do any of your cost breakdowns take into account inflation, regulatory legal delays, logistical delays, et cetera? And, I was wondering how much of a factor economics has come into play in the disposal of the waste?
[Discussion]
Is it safe to say then it wouldn't be economically prohibitive to ship the waste to Nevada or Washington for those methods of disposal?

WILLIAM TRAVERS: We found that to be the case in what we did.

ERIC EPSTEIN: I will spare the panel and the crowd just one more question. Question 6, I was wondering, do the maximum dose rates assume that all plant, aquatic and human life are chemically and radioactively pure before they're exposed to radioactive emission from the water?

WILLIAM TRAVERS: I'm not sure what you mean.

ERIC EPSTEIN: I mean when you say that a person exposed to X amount of radiation, are you assuming that that person has never been exposed to radiation before, eating food or --

WILLIAM TRAVERS: No. What we have looked at is the incremental risk that could be estimated to be associated with any of the alternatives.

ERIC EPSTEIN: What do you mean by "incremental risk?"
[Discussion]
Those are the five questions I had, and rather than proceed with the other 16, I will wait for the formal response.

ARTHUR MORRIS: Thank you.
Just as a follow up to one of Eric's questions: The on site storage question on low level waste versus not low level waste, that would be contained if it would be followed through with in concrete?

WILLIAM TRAVERS: That is one way it could be contained, but basically there has to be a finding, and again it is not storage. It is actually disposal.

ARTHUR MORRIS: The reason I am asking about concrete, I believe part of this said even in that method, you end up losing 50 percent of the tritiated water in any event.

WILLIAM TRAVERS: Early on. You lose it all eventually.

ARTHUR MORRIS: But very early on, you end up losing 50 percent by evaporation in any event, so you really end up holding 50 percent of it in the concrete or whatever it is you hold it in.

WILLIAM TRAVERS: What you would bind up is the other material.

NIEL WALD: I am necessarily addressing this to the two people at the bar of justice here, but a number of people alluded to the economic factor and the choice of waste disposal being dictated by the economics. I was wondering if I am missing or misinterpreting the table which compares -- Table 5.1 which says that storage in tanks on the site is by far the cheapest method of any of the ten that were looked at by the NRC. Am I correct in interpreting it that way?
[Discussion]

ARTHUR MORRIS: That is storage in tanks on site that you are looking at?

NIEL WALD: Yes. Zero to 1.2 million, which is the upper figure is still lower than any of the lower figures for any of the other methods by anything from a factor of two to six times lower.
[Discussion]

THOMAS SMITHGALL: I'd like to ask one other question. I guess this is for both Bill and for Frank. I'm curious as to whether or not any preliminary bids have been set out or preliminary contracts let or any materials ordered or procured by GPU in anticipation of the evaporation process being approved by the NRC?

FRANK STANDERFER: No actions have been taken of that character. The only thing we have done is asked for bids to supply this equipment so we can understand the cost and the type of equipment better. No contracts would be pursued until we understand we have an agreement on the option. It wouldn't be valuable -- if we signed the contract without the approval to dispose of material this way, then we would be subject to costs to break that contract. So we are just getting the background information we need so that we understand the process better.

THOMAS SMITHGALL: That's all I have.
[Discussion and adjournment]

Comments Received at the March 25, 1987 TMI Advisory Panel Meeting

RICHARD PICCIONI: My name is Dr. Richard Piccioni. That is P-i-c-c-i-o-n-i. I work with a group based in New York City called Accord Research and Educational Associates.

I think there is another group in this neighborhood called Accord, but it's not the same. We have been in existence since the late spring of 1979. In the early summer of 1980 our group conducted around-the-clock monitoring of airborne particulates and gaseous krypton-85 during the venting of the TMI Unit 2 containment.

We have submitted critical comments to the clean-up proposals that have been published and their revision of dose effects and dose rates which were subsequently released, and we have an active and continuing interest in the TMI situation and the clean-up procedure.

My own credentials are that I have a PhD in biophysics from the Rockefeller University in New York which I received in 1977, and subsequent to that, did three years of post-doctoral research in the Department of Cell Biology and Biophysics also at the Rockefeller, and I was teaching and doing research as an Assistant Professor at the City University of New York, Hunter College for five years.

Currently I am Senior Staff Scientist with Accord Research. It's a non-paying position which I do on a voluntary basis.

In reviewing the proposals for various approaches to be taken in disposing of the water which was generated during and subsequent to the accident at TMI we came across in the proposal which was finally endorsed by this document, The Environmental Impact Statement, NUREG-0683 Supplement 2, the statement that the favored alternative, which involves evaporation, forced evaporation of the some 8 million liters of contaminated water, the forced evaporation will result in the release to the environment of approximately one percent of the estimated one curie of strontium-90 which is present in that water.

I am not in a position to critically evaluate the value of one curie in the contaminated water. I'm taking that as a given, but this isn't anything I say from henceforth and does not constitute any kind of an endorsement of the validity of this number. I wasn't involved in determining it and, frankly, I hope it is that low.

Similarly, the one percent release I won't dispute here just simply because I'm not provided with the technical basis to do so. Again, I'm taking that as a given and I hope again it is that low.

However, what I do want to deal with explicitly are the consequences of releasing into the atmosphere what will be something on the order of 10 millicuries of strontium-90.

Now in this document it's stated and it is not something which is unusual to find in published material from the nuclear industry broadly speaking and with support from the Regulatory Commission that releases of these kinds of say millicuries of strontium-90 are not significant. That is, they do not have health significance. They are far below the releases which are permitted on a routine basis from operating nuclear reactors.

Well, I disagree with that position vehemently, and the basis of disagreement is contained in my appreciation of the biophysical mechanisms of the action of radioactive materials on living things.
Now in this area of nuclear technology and in particular in the area of public involvement in nuclear technology it is very important that the people who are most affected by this technology, namely, the public, understand as clearly as possible what it is that is being proposed in any particular action that is going to be taken and, indeed, what is involved in the whole business of nuclear development.
So we need then to step back a little bit and look at what is involved when you release into the environment radioactive materials.
Consider a single radioactive atom, a single atom of strontium-90. This is a substance whose chemical nature determines where it is going to go. Strontium is an element which has a lot of similarities chemically to calcium.
So when it is released into the environment, a substantially high fraction of it, that is, in comparison with other kinds of materials, enters into the biosphere, namely, that portion of the world which is alive. It enters into it because calcium is a crucial element in the metabolism of plants and animals and strontium, as we said, bears enough similarity to calcium that it is taken in and it becomes part of the biosphere.
Now each strontium-90 atom is traveling through its time on this planet with its own kind of internal death certificate, and sooner or later on the average about half a chance, a 50 percent chance every 30 years, it will undergo decay and in doing so release energy from its nucleus. This energy is released in the form largely of a high-speed electron. It's a charged particle that comes flying out of the nucleus, and this electron that comes out has enough energy in it to cause very drastic chemical disruptions among the molecules that are in the vicinity of the decaying strontium-90. Now so much for the physics. What about the biology and specifically the molecular biology? We know now that living things are alive by virtue of extremely complex and actually rather delicate molecular structures, the genetic material primarily, and that these structures are highly sensitive to the effects of agents such as ionizing radiation which disrupt that structure. They are capable of some repair, but that capability of repair is not unlimited.
There is some redundancy in the biological system, but that redundancy cannot cover all contingencies. So it is known now on a firm scientific basis that every incident of exposure of the genetic material of a cell to the influence of ionizing radiation carries with it a finite chance, a finite probability that the cell that is exposed, that the genetic material which is exposed will be changed, altered in a deleterious way. That is, when you release into the environment radioactive atoms of strontium-90, you are necessarily damaging genetic material of plants, animals and people in the environment. You cannot avoid that if you release the material into the environment. Once you have released it, you can be certain that that effect will take place. There is no way that it cannot take place.
Now the world is large and there is a lot of air, there is a lot of water and there is a lot of space. So if someone miles away from you releases

a few billion or a few billion billion atoms of strontium-90, well chances are none of them will reach you or maybe one or two, but they will reach other people, and, in fact, you can be sure that if you are releasing radioactive materials into the environment, say into the air or into the water, that some of those atoms will indeed reach some people somewhere. You can't avoid this as long as your releases are on the planet.

Now the question which gets confused with this basic reality is can the effects be observed and can the effects be measured, not the radioactivity that can be easily measured, but can the effects on people be measured. That question is confused with the non-question that there are effects.

Now I understand how this comes to be because the nuclear industry, its civilian activities, its military activities and its activities which apparently both civilian and military if we are to understand the recent announcement from the DOE of their interest in converting commercial nuclear power plants to plutonium production facilities for the military, maybe it's a mistake to even make a distinction, but all of these activities, the production and testing of nuclear warheads and the operation of nuclear power plants must result in the release of radioactivity into the environment.

It simply has not been developed, the technology has not been developed with the capability of not releasing radioactive materials into the environment and so they are released and so genetic material, genetic information in plants and animals and human beings in that environment is necessarily affected. There is no way that cannot be true.

But, on the other hand, the nuclear industry has a very important stake in asserting, first of all, in making sure that people are unclear on the inevitability of the damage and also in establishing criteria and methods for determining the effects that result in negative finding.

So from the point of view of an independent scientist who is coming to this scene, I have had to take a look entirely at the whole picture of what is released, what do we know about what the effects must be and what are our various tools at our disposal in uncovering and revealing what those effects on people have been, and in particular, evaluating whether those tools are sensitive enough to detect what in effect has to be there.

Now when we monitored the krypton release in 1980, we detected in the krypton plume strontium-90. That strontium-90 was not supposed to be there. There was a lot of strontium-90 in the reactor at that time especially, about 100,000 curies, but the filtration methods were supposed to be good enough to keep the releases down to a level approximately 900 times lower than what we observed.

Now why, by the way -- people may be wondering why did we observe strontium-90 and Met-Ed did not, GPU did not and the EPA did not. It's very simple in case are unfamiliar with the particular history of this. We did a lot of driving and not a lot of sleeping during those two weeks and we made sure that during that time when we were sampling the air, that we were sampling the plume and not background air.

Now the trouble is that since the testing of nuclear warheads began the globe has become contaminated with strontium-90. This is very well

known. And if you filter air up or downwind of a nuclear reactor, you will always pick up a certain amount of strontium-90. That represents a background of strontium-90 against which you have to make a comparison when you are monitoring a release. Your ability to make this comparison is limited very substantially by the amount of background air you filter as compared to the amount of plume that you filter.

So we were very active during this period of time and we drove continuously around always staying down wind, and in that way we were able to obtain a very high ratio of plume air versus non-plume air as passing through our filters.

As a result of this, we were able to find nine times as much strontium-90 present on the filters as would have been there had there been no release. So we feel very sure that strontium-90 came out, and these quantities were, as I said, several hundred times, 900 times higher than we had been assured would be released during the venting.

Now again returning to the situation with the accident generated water, keep in mind that the release which is predicted, now predicted in this document for the proposed method is as large as the release which we measured, that is to say, 900 times the release which was promised before the krypton venting by the reactor operator.

Now in our reporting of our findings of the krypton venting and the strontium-90, we found in that plume we made predictions of possible health effects that were going to result from the dispersion of this seven millicuries of strontium-90 which was released.

ARTHUR MORRIS: Can I just ask for a point of clarification real quickly on the 900? You're saying 9 and 900. Is it 900 percent or is it 900 times greater?

RICHARD PICCIONI: Basically, GPU said nothing is going to come out but krypton and it had some extremely low value. We found 900 times that as our calculated release.

ARTHUR MORRIS: Nine hundred times ---

RICHARD PICCIONI: Nine hundred "x".

ARTHUR MORRIS: Thank you.

RICHARD PICCIONI: 90,000 percent.

Now here we have a situation where part of the plan is to release that much, one percent of the supposedly one curie that is present in the water.

At the time when we were evaluating the effects of the seven millicuries that came out from the krypton-85, we predicted that through the mechanism of uptake by agricultural pathways, people eating food, somewhere, wherever there were people eating food grown in this area or from this area, there would be a handful of extra cancers. Our estimates were roughly 20. This was based on a model of dispersion of the percent of the strontium-90 released that would find its way into the food chain and of established values for dose and effect of strontium-90 in adults.

But we were only looking at really one effect which was cancer. Now what I'm here to do partly and why I drove in from New York today and have to drive back tonight is basically to issue an apology for that estimate because since that time, and this was now six years ago, there have been a large number of papers which have been published and evidence which has come to light that the hazards of strontium-90, in particular when introduced into the food supply, are vastly greater than we had thought and that our estimate of 30 cancers or 20 cancers among those eating food contaminated with the release during the krypton venting could be grossly in error, grossly in error quantitatively and qualitatively.

We may have been underestimating the cancers, but perhaps more importantly, we may have been excluding effects on people other than cancer which, in a numerical sense, were far larger, and in particular, the effects on infant and fetal mortality.

You will be hearing in a few minutes from Dr. Sternglass who is one of several people who have contributed to this increasing base of data that give us more reason to be concerned about strontium-90 than we used to be. So I don't need to get into it myself.

But suffice it to say that I feel no less concerned about the effects of releasing into the environment 10 millicuries of strontium-90 now or let's say over the course of the next 28 months than I felt in 1980 when we got the results back from our filters. In fact, I feel quite a bit more concerned than I did at that time.

Now you don't have to release that material into the environment. You don't have to release that one percent, and if we are lucky, one curie of strontium-90. You don't have to do that. You don't have to evaporate that water or dump it into the Susquehanna.

You say that it is possible yourselves in this report, or I shouldn't say yourselves, but in this report it is outlined, an alternative, which is on-site storage accompanied by retreatment of the water in order to separate from the water the radioactive strontium-90.

Now I think this proposal is the only one which is morally acceptable because it does not involve releasing into a highly diffusible medium, namely, the air or water radioactive materials. Those radioactive materials are separated from the water, solidified, and placed in a burial context in which at least there is a chance that their release into the environment will be delayed, and that is vastly preferable to simply letting it go.

Now from that point of view, it is, as I said, the only morally acceptable solution. There is some discussion about what if there is an accident in future involving that stored water, and our reply to that is fine, the consequences of that accident should be mitigated in advance by treating the water repeatedly in order to lower the Strontium 90 concentration which is in that water as low as is practicable and certainly two or three treatments would not be excessive.

Now there is a major advantage to this over releasing it. First of all, you say that there is a curie in there and you say that one percent only will be released, but you won't know that until after it has already happened.

On the other hand, if you are wrong about the quantity that is in there, the quantity of strontium-90, if there is more strontium-90 in there than

you think, passing the water through repeated purifications enables you to know what the heck you're doing before you're in any position that you're going to release it. You pass it through, you pass it through again and you pass it through again and at each stage in the process you have an idea as to whether your predictions are correct.
But if you go ahead with the evaporation, you won't know until it's over whether or not you were wrong again.
So that's about all I have to say and I hope it's been clear.
(Applause)

ARTHUR MORRIS: Do any members of the panel have questions on the testimony at this point?
Niel.

NIEL WALD: You gave a figure of 20 extra cancers out of how many that would have occurred without the strontium?

RICHARD PICCIONI: Hundreds of thousands. It doesn't mean a damn thing. Twenty people dead because of the activity of the nuclear industry. That's 20 deaths. You only have to kill one person in many states in this country in order to yourself suffer capital punishment.

NIEL WALD: I think you answered my second question which was going to be whether these were fatalities or not. Are you saying what you figured were fatal cases?

RICHARD PICCIONI: After the Chernobyl accident, it was stated to the public apparently with a straight face that 25,000 people may be dead in the future as a result of the contamination of the environment with the radioactive materials that came out of that plant, and we were forced to listen to a comparison of that number with the number of spontaneous cancers which would normally occur.
Now I am a scientist by training and I'm supposed to be calm. But this is the one question that gets my blood boiling and you've asked it. It is the essence of the immorality of the nuclear industry that such a question would even be asked.
(Applause)
It is the basis of the industry that the death which is distributed by the nuclear industry is distributed over many people dying of the same cause and that it is statistically hidden and that is how we have a nuclear industry in this country is because of that basic factor of concealment as well as the astonishing moral acquiescence of scientists in that industry to accept these deaths as being somehow insignificant because they are among others that they did not cause.

NIEL WALD: I'm sorry. I'm not sure you answered my question.
No. 1, what was the population in which those 20 extra cancers arose? What size population? If it's 25 people, it's quite different than if it's 25 million people.

RICHARD PICCIONI: No, it is not different.

NIEL WALD: But you said you used a model and you have to do some calculating. You can't just work with a numerator without a denominator.

RICHARD PICCIONI: You distribute into the environment a certain number of millicuries of strontium-90 and you have a factor which is your estimate of what fraction of that strontium-90 will be consumed. The population size does not matter according to come up with that number. You come up with a population dose, a number of person rems which will be received among all people consuming food that contains that strontium-90.

NIEL WALD: Right, and that's the figure I'm asking for. How many people?

RICHARD PICCIONI: It could be a child in Harrisburg or it could be a child in West Germany eating Pennsylvania cheese. I don't care. The 20 people are as dead distributed over thousands of miles as if they were together sitting at this table.

NIEL WALD: I'm still asking. You mentioned person rem. My understanding of it is you multiply the dose by the number of people exposed to it. So you have to have persons, and I'm just asking how many persons you considered in doing the calculation.

RICHARD PICCIONI: No, you don't. You don't have to.

NIEL WALD: A person rem you don't need persons?

RICHARD PICCIONI: No, you don't. You come up with a percentage, which is the amount of strontium-90 which is going to be consumed. One percent we said of the strontium-90 will be consumed, and that is a certain number of curies. That results in a certain number of person rems. Look at NUREG 1.109. It converts curies consumed to person rems.
[Discussion]

NIEL WALD: Were these fatal cancers or non-fatal, the 20?

RICHARD PICCIONI: The 20 were fatal cancers and you can double it for non-fatal.

JOHN LUETZELSCHWAB: How many person rems did you calculate it to be then?

RICHARD PICCIONI: At that time?

JOHN LUETZELSCHWAB: Yes.

RICHARD PICCIONI: We used a factor of 1,000 cancer incidents per person rem.

JOHN LUETZELSCHWAB: And how many person rems did you calculate from the seven millicuries?

RICHARD PICCIONI: Well, from the seven millicuries we are talking - - we just do the arithmetic the other way. So it's 20. So we are talking 40,000.

JOHN LUETZELSCHWAB: 40,000 person rems from seven millicuries?

RICHARD PICCIONI: Right.

JOHN LUETZELSCHWAB: Back in 1976, the Chinese had a weapons test and the whole East Coast was blanketed with fallout. I don't have the numbers on strontium-90, but I'm sure it's more than seven millicuries, a lot more than seven millicuries. Did you do any work with that incident as to how many cancer deaths were caused from that?

RICHARD PICCIONI: Sure. I mean it's the same calculation.

JOHN LUETZELSCHWAB: Do you have a number then on how many you expect?

RICHARD PICCIONI: Well, no. I mean I don't have a number of how many to expect because we don't have a number here about what the total number of millicuries or curies of Strontium 90 that were deposited where, but it's the same calculation.

JOHN LUETZELSCHWAB: If we take your extrapolation or calculation of seven extra cancer deaths for seven millicuries, and, Tom, do you remember what that was?

THOMAS GERUSKY: (Nodding negatively)

JOHN LUETZELSCHWAB: I would assume it's in terms of kilocuries possibly for the whole East Coast. You're talking about a million times more. So you are talking about 20 million deaths from that?

RICHARD PICCIONI: No, not necessarily. It is not kilocuries on the whole East Coast. It was a small yield bomb.

JOHN LUETZELSCHWAB: Seven curies -- it's 20,000 deaths then. I just have a little trouble accepting that.

RICHARD PICCIONI: How many do you accept?

JOHN LUETZELSCHWAB: Seven millicuries? I would say a fraction of one based on dose calculations.

RICHARD PICCIONI: Well, we differ in our assumptions.

JOHN LUETZELSCHWAB: Okay.
[Discussion]

JOSEPH DiNUNNO: You're concerned in a biological sense with radiological stress on genetic materials. That seems to be where you were heading and the basis of your arguments. What about other stresses that occur as a result of many activities of our industrial society?
If I gather the direction of your argument, you would turn off all radioactivity because of this concern of yours, and I'm not criticizing it,

but I'm trying to understand where you're coming from. But there must be other things that create similar problems and have you looked at those and are we going to turn all those off as well by your theories?

RICHARD PICCIONI: Well, the first thing we have to do is stop concealing the reality from the public and let them decide.

JOSEPH DiNUNNO: Well, the realities are those that you've just articulated; namely, that radiation does cause damage to biological materials, but this is certainly nothing that has been hidden. This concept is very fundamental and it's been articulated time and time again.
As a matter of fact, it's my understanding that awareness of this has been the basis for establishing radiation protection standards. So it's been basic to the industry.

RICHARD PICCIONI: No, I disagree with that. I think the basis for establishing radiation protection standards is to protect the industry in particular so that there is no single individual or worker who receives a dose which is high enough that they would have a fighting chance in court to prove that their own problem, or it would be the problem of a relative, came from that exposure. By keeping the exposures limited for any one individual, you make sure that the risk is distributed over a large number of people and that way, you are in a much stronger position legally to defend against the attack of any one person that the leukemia that they are dying from or the leukemia that their father died from was caused by that industry.
So the reason for the establishment of those standards is quite clear in terms of the practicality of running an operation such as the nuclear industry in this country. It seems clear to me.

JOSEPH DiNUNNO: Well, that suggests that the entire health and safety protection business has been in cahoots with the nuclear industry, and I find that a bit hard to grasp, but that's what I gathered that you're saying - that you can't trust anybody that develops a health and safety protection standard because that's done to protect the industry.

RICHARD PICCIONI: Well, that's your way of putting it. I don't know.

JOSEPH DiNUNNO: Well, I'm just quoting what you're -- I'm feeding back to you what I heard, and I'm just trying to confirm that that's where you're coming from.

RICHARD PICCIONI: When people talk about releases that have no effect or when the nuclear industry talks about releases that are without effect and that are of no impact to the environment, and you hear statements like this many times a year that various incidents will occur and no effect is expected and these releases are well below regulatory limits. It's a standard method which is used. Workers are exposed to doses up to the legal limit until they have no risk and there are many anecdotes of this, of people who have encountered that.

JOSEPH DiNUNNO: I have to say that that's not true. I have never seen any standard that has not been put in terms of probability. All of these models that you're talking about using, those that you've used, and those that the radiation protection people are all couched in terms of probabilities. So that the probability of these happening always has to be presented in terms of the probability of a number of cancer deaths. One always has to deal in probabilities, and generally, when those probabilities are one in a million and one in 10 million or one in 100 million, then there are decisions or there are observations that are made that these are insignificant risks, but they are always associated with a low probability of some kind or other.

RICHARD PICCIONI: Sure. There are three avenues of deception basically. One is, and I insist upon it, that qualitatively it is not made clear to the public, it is not made clear to those who are working with radiation and radioactivity, that they are exposed to risk no matter what the level. It may be in the BEIR report. It may be in NUREG 1.109, but it is explicitly by active intent of the nuclear industry not in the minds of the people who are being affected.
No. 2, you misestimate what those probabilities are and you close your minds to the possibility that your estimates have been wrong. They have been creeping slowly downward over the year as the evidence has accumulated, but you are way behind the times, and more and more evidence is accumulating that the levels which you say are acceptable and that the probabilities that you are calculating are off by factors of 10 and 100, and yet the NRC is asking for an increase in the allowable occupational exposure to substances like strontium-90. So that's a second avenue.
The third is the releases themselves, the quantities that are emitted and the methods that are used to measure them.
Why can an outfit with an operating budget of zero coming down 200 miles from New York City with a half a dozen guys missing work measure radioactivity that the elaborate trucks of Met-Ed were unable to measure because they were too slow to move around. It's a lack of a desire to prove and find out what in fact is going on.
So there are three levels by which the problem remains.

THOMAS GERUSKY: Can you explain how you did that, how you determined it was strontium-90 on your filters?

RICHARD PICCIONI: Sure. We sent the samples to Teledyne.

THOMAS GERUSKY: And what?

RICHARD PICCIONI: And they did a determination. We calculated the volume of air which was filtered and we compared it to well-known values of the background strontium-90 concentration in the air, and low and behold, it's three standard deviations above and a factor of nine.

THOMAS GERUSKY: And Teledyne is a nuclear industry laboratory?

RICHARD PICCIONI: They didn't know where the samples came from. If they were in the business of fooling around with their samples, they wouldn't be in the industry. Besides, we've sent them lots of stuff, including dope samples.

JOSEPH DiNUNNO: Doctor, I would like to make another observation, and it goes something like this. One of the things that we in the scientific community do so poorly, as you've indicated, is explain to people what is going on. We try and we aren't always very successful.

I think what confuses people more than anything else is that you can get a group of scientists to talk on a subject like this, and you'll get different views. I'll sit here and I'll give one view and you sit there and you'll give another view, and the people out there don't know which one of us to believe.

We may both be very honorable people, but we aren't doing a service unless we are very thorough and very careful in our statements. We are not serving the public very well. We place them in a position of trying to guess who are the experts and who do I believe.

Tonight we're listening to you and we're listening to Dr. Sternglass. I have papers here that provide comments from very reputable doctors and people from the National Committee on Radiation Protection, very honorable people who have studied this problem for years and years. They differ totally with what you're saying.

Even as a scientist I'm faced with the decision of who do I believe and who do I tell these people out there that they out to trust? It's a very difficult thing.

RICHARD PICCIONI: This problem was decided probably two or three thousand years ago by Greek philosophers who looked into it. You find those who neither profit nor lose by a decision. You don't take the word of people whose lives are invested in the continuance of an industry. Why would you think that those people should necessarily act or should be able to act against their own interests? It's kind of naive.

ARTHUR MORRIS: In an effort to keep things going, I think we're getting into more of a philosophical discussion, which is okay I think, but we have other people that want to speak to the question.

I would like to ask a question, if I may, and that is, you indicated that there is an option that would, I don't know if the word was recommend, but I would sense that from you, that nothing be done at this point other than retreating the water two or three times, I think you said, would not be too much.

My question to you is, you indicated what the content was of the strontium now. What would you anticipate it would be, if you have any idea, after treating it several times, and at what point is that acceptable to deal with and how would you deal with it at that point?

I mean I hear you saying, I think, that no level is acceptable. Can treatment get to that point?

RICHARD PICCIONI: Well, if no level is acceptable, then you can't get to that point. Every time you treat it ---

ARTHUR MORRIS: I'm just asking you that.

RICHARD PICCIONI: From the values which are in this report, it looks like you drop about a factor of 10 every time you run it through the filters. So you starting out at about ten to the fifth picocuries per liter. So run it through three times and keep the stuff on site from now on.
I realize it's an inconvenience, but you should have thought of that before you built the plant.

JOSEPH DiNUNNO: May I comment on that? Reading the testimony that was given last time, that's not correct. As I understand the operation of the filters, the decontamination factor is a function of the concentrations in the material, and as the concentrations go down, the decontamination factor goes up. So that, as you are lowering and lowering concentration, the amount you remove with each pass becomes less and less.
So to go with that last increment that you would like to go, I don't know how many times you would have to go through that, but it would be many times.

RICHARD PICCIONI: It sounds very expensive. I'm sorry.

ARTHUR MORRIS: Well, if I could just for one last second here, at what level, is really what I'm asking you, at what level would be something that you feel then can be dealt with ---

RICHARD PICCIONI: Can be safely stored on site for an indefinite period of time?

ARTHUR MORRIS: Well, is that what you ultimately recommend?

RICHARD PICCIONI: Yes.

ARTHUR MORRIS: That you retreat, but you still store on site?

RICHARD PICCIONI: Yes.

ARTHUR MORRIS: That answers my question. I didn't know that.
Thank you.
[Discussion]

ANNE TRUNK: I would just like to ask if we store it on site, what about all the people that live near Three Mile Island who don't want it on site?

RICHARD PICCIONI: Right. I understand that.

ANNE TRUNK: What is the moral value of that?

RICHARD PICCIONI: The contents of this water are isotopes which are not going to be released outside of any kind of substantial containment. There is no reason to think that there is any way that there are going to be effects on people outside of the boundary of the reactor.

I can't tell you that it's going to be as if you didn't have a nuclear power plant here and it hadn't had an accident, but it did. You did have the accident and you did have the reactor and you did have the accident. The waste has been generated.
I think it is morally wrong to release it into the environment. I'm sorry.

ANNE TRUNK: And I think it's morally wrong to make a dump site right next to my house, you know. It comes down to that.

RICHARD PICCIONI: Well, okay. I'm sure that other members of this panel will be delighted to see a struggle between two victims of their technology, and I think we have to figure out what to do with this.
There may be another alternative which hasn't been enumerated. Among the ones which are listed there, the only one that didn't involve releasing into some neighborhood where people were was to keep it there. But I would be very interested in looking at any other way in which that can be avoided.
But it can't be that we are being put in the situation where the choice is my kids or your kids. It should be nobody's kids.
(Applause)

ANNE TRUNK: Okay. Let's ignore the recommendations from the book. Do you have any?

RICHARD PICCIONI: I don't have any at this time. We have to work on this problem. It's an enormous problem. This is a tiny piece of it. We have radioactive wastes up to our ears from this reactor and from other reactors and from the weapons industry. It's an enormous, enormous problem that we have to start to find out how to solve.
We have to try to get some people together with some professional independence and integrity. We have to start looking at technical alternatives. Are there ways that you can take radioactive materials and keep them away from the biosphere for thousands and thousands of years, irrespective of the cost. We have to start to do that. It hasn't started yet, that process. They are still trying to figure out how to make the nuclear industry work, including how to get that reactor operating again, whether it produces electricity or warheads, and their starting position is there and it's the wrong starting position.
If the starting position was how do we protect people in the environment, we'll come up with answers.

ARTHUR MORRIS: I'm going to take two other questions from two panel members and then we do need to move on here because there are other speakers and we need an opportunity to question them.
I think Niel had mentioned that he had a question.

NIEL WALD: Mine is a comment rather than a question because I'm not sure that in trying to enlighten the public, which is part of the mission of this panel, and we don't work for the industry, the concept of models and the uncertainties, and you as a scientist recognize that when you're working

with a problem where you can't visibly identify and measure an effect, you develop a model and you hypothesize, which means you use your best judgment in constructing the concept which says even though the effects that have been detectable and visible are at a high level of exposure, that in some way I reach the equivalent all the way down to low doses. That's the business of developing a model, and that is the basis for your findings in terms of the health impact and the extra cases of cancer that you mentioned.

I think it does the public a disservice not to make it clear that this is a matter of your judgment and any one who constructs a model makes assumptions and it's a matter of their judgment.

There is a lot of model making going into this because of the need for radiation protection standards, and I have to say, because I worked in Karl Morgan's division, that I object to the idea that Karl Morgan, who is the leading figure in developing radiation protection standards, was doing it to avoid some company out there being sued. That was not why ---

RICHARD PICCIONI: You should talk to Dr. Morgan now and see how he feels about this.

NIEL WALD: Well, I think he did a good job.

RICHARD PICCIONI: By the way, I agree with what you're saying entirely, that it is a dangerous extrapolation to take results on radiation effects obtained really at high doses and high dose rates and extrapolate them down to low doses and low dose rates.

It appears that a simple linear extrapolation tremendously underestimates what the biological impact actually is.

NIEL WALD: One other point I did want to mention is that I think for the human at least that the health impact should be mentioned. You've worked in molecular biology and I know that your frame of reference is different than mine, but my concern is identifiable health impacts and I think there may be a lot of steps in between with mitigating influences that correct for biological damage, especially at very low doses and low dose rates which may prevent the molecular changes that you described from ever appearing as a health impact on the individual that's the host to all those cells, and I think that step shouldn't be blurred.

RICHARD PICCIONI: No, but fortunately there is some experimental data on this and the experimental data are not comforting. They suggest that in fact there may be mechanisms of radiation action at low dose rates and low doses that are not operative at high doses and high dose rates. So that in fact, as I said, extrapolating down may be dangerously optimistic. That's based on experiment.

NIEL WALD: And there are some that point in the other direction.

FREDERICK RICE: You mentioned that we could be grossly in error and maybe we're excluding effects other than cancer. What do you meant by that?

RICHARD PICCIONI: Infant mortality and fetal mortality in particular.

ARTHUR MORRIS: Thank you very much for taking the time to be with us today and be willing to sit here and answer questions for some 30-some minutes. Thank you.
(Applause)
Dr. Sternglass.

ERNEST STERNGLASS: My name is Dr. Ernest J. Sternglass. I'm Professor Emeritus of Radiological Physics at the University of Pittsburgh. I have been engaged in research in the effects of low-level radiation and techniques of reducing X-ray dose since 1952.
I'm a member of the Radiological Society of America, a Fellow of the American Physical Society, a member of the American Association of Physicists and Medicine, I've taught courses in health physics at the University of Pittsburgh under the direction of Dr. Niel Wald, and I was appointed to the Health Physics Society and recommended by Mr. Thomas Gerusky.
So these are old friends of mine to whom I'm now going to be able to talk about what has happened in the last seven years since I came to Harrisburg on March 29th and urged the evacuation of pregnant women.
Now we have the unusual and, in some way, the sad and tragic opportunity to look at the actual statistics as to what happened in the last nine years. Time will judge whether or not there really have or have not been detectable effects.
In order to do this, I would beg your indulgence to be able to leave this table and go over there to the projector so that you and the public can see the nature of the evidence that is involved in this matter.
May I do that?

ARTHUR MORRIS: Yes, please.

ERNEST STERNGLASS: Thank you.
(Slide)
I believe that the principal issue that has now crystallized as a result of the discussion we just heard is whether or not --
(Pause due to slides dropping)
I'm sorry about this.
What we have to try to recognize is that the question is not one of whether there is an effect. All of us are agreed that there is some damage from radiation at every level. It's a question of whether it's less or more than we expect.
So what I want to do today is very briefly go over with you the evidence that indeed we have grossly underestimated the effect, that indeed there have been serious impacts on human health wherever nuclear releases have taken place, whether from weapons testing or Three Mile Island or the normal operation of nuclear reactors or the distant fallout from Chernobyl.
Now how do we know that small amounts of radiation are dangerous?
What you have to realize is that for 60 or 70 years diagnostic x-ray work, which has been my field, there was no evidence whatsoever that

small diagnostic doses comparable to a natural background of 100 millirem per year, 10 millirem in a typical chest x-ray, or 200 millirem in an abdominal x-ray, that these doses have produced any ill effects in man at all, especially in adults or women.

The point that I'm now trying to make is that within the last 15 years, roughly since about 1972, our whole conception has changed.

The first person who was responsible for pointing out that we had underestimated radiation effects was Dr. Alice Stewart at Oxford University who in 1957 or '58 looked at why leukemia among children in England had risen so much, and this is the key thing. Until 1957, 12 years after the first atomic bomb test and the very year that Shippingport went on line in this state, she discovered that women who had had one or two or three or four diagnostic x-rays, ordinary diagnostic x-rays during pregnancy had almost 50 to 100 percent, or nearly double risk that their children would die of leukemia and cancer.

Now that is an enormously greater effect than for the adult, typically a hundred times. But what she discovered even later is that the fetus in the first trimester is 10 times more sensitive. So that when we talk about radiation in the environment where women are pregnant in the first trimester, we would expect a thousand-fold greater risk than for the normal adult like you and me.

Now what she did was so controversial that nobody wanted to believe her, and no radiologist and no gynecologist and obstetrician wanted to believe it.

So she went back and collected more and more data until by about 1970 or '72 she had developed a data base of many millions of women who had been, 5 or 10 percent of whom had been x-rayed during pregnancy. And then she found the following direct relationship between the risk of the child developing cancer and the number of x-rays given - one, two, three and there was a direct line relationship in an article published in Lancet in 1970.

This was the most convincing evidence because it had nothing to do with the question as to why the women were x-rayed. It was simply that those who got one got one risk and those you got two got twice the risk and those that had three had three times the risk.

That is a linear relationship which is extremely important and has completely upset our ideas as to how dangerous radiation is.

Now the question was raised that maybe there is a repair process, as mentioned by Dr. Wald, and everyone was hoping that there would be. So that in the environment over a period of weeks or months, there would be less of an effect.

Now it so happened that in Japan Dr. M. Segi at Tohoko University was gathering statistics from the World Health Organization all over the world and published them about leukemia and cancer in children following the atomic bomb tests and this is what he found.

Now the question I want you to look at is do you think there is something like a detectable peak?

(Slide)

Now here is the 1935 to 1968 rate of cancer mortality in five to nine-year-old males, and you can see that until the bomb, there was no

increase. All the medical x-rays we were using and using in Japan did not produce a rise in leukemia among children.
But suddenly after the bomb arrived all over Japan and not just on Hiroshima, there was a 600 percent increase in the total number of leukemia per 100,000 population corrected for the change in the number of people.
Now the question is, you have to decide in your own mind, assuming that Dr. Segi's data is correct, and assuming that you can go into the library, as you can, and check this plot as to its correctness, whether or not this represents a detectable effect. And I can only say it is you who have to decide. I am clearly very concerned about the need to reduce the medical x-ray dose.
I've spent my scientific life trying to do this. That is why I was hired by Dr. Wald to help reduce the exposure of radiation to people under necessary medical conditions. But I discovered that fallout was defeating what we were trying to do in reducing x-ray dose, and this is the question that only you can decide.
(Slide)
Now the next question is, was it the worst thing? Actually, no. It turned out that we had overlooked another factor which was not discovered until 1972. In 1972, an article was published in Health Physics, and Dr. Wald was head of the Health Physics Society at one time, and Dr. Morgan was the editor of that journal. He reviewed it carefully and published it.
This article was published in 1972 in Health Physics in March by Dr. Abraham Petkau of the Canadian Atomic Energy Commission - not exactly a wild-eyed radical. He was in charge of the medical laboratory trying to reduce the impact of radiation on human beings.
And accidently he discovered that when you took a cell membrane and irradiated it in water with a beam of medical x-rays, it took three thousand rads or three million millirads to break that membrane. But when he added a little radioactive salt to the beaker and just waited until the membrane broke, he discovered that it took less than one rad to break that membrane over long period of time.
In other words, completely opposite to what all previous animal and other studies had led us to believe. What had happened is that we had overlooked a whole different biological mechanism called the production of free radicals, including O2-. O2- turned out to be the criminal in this particular case. It is a free radical that attacks cell membranes and actually unzips them. And since then we have been able to show that when oxygen does not exist in the fluid, then the effect is much less severe.
Unfortunately, you and I in our bodies have enzymes to protect us to a very significant degree from these biological effects of free radicals. But over the last 10 or 15 years, an enormous literature has sprung up that shows that free radicals have an enormous impact on all causes of death, heart disease, lung disease, emphysema, damage to the urinary kidneys and all other diseases.
This was an article just published in Science a few weeks ago about a conference on the extremely great danger of O2-, which is, by the way,

produced by all or most ordinary carcinogens as well as radiation. We overlooked this completely.

What he discovered is that the more protracted the dose was, the greater was the effect, completely contrary to what we had known from animals or the use of radiation in x-ray therapy. When you space it out, there was less of an effect, and that is the reason that we developed a radiation standard based on that assumption, that things could only be better if they are spread out over a long period of time.

But as a result of the fact that small amounts of radiation are more dangerous, the response curve is not just linear the way Dr. Stewart found, but it actually is superlinear and rises much more rapidly in low doses. So that when we extrapolate from data taken up here, and that's the data we had at Hiroshima and that's the data we had from medical therapy of millions of patients and hundreds of thousands of animal studies. All the data existed up here.

We extrapolated down and the extrapolation turns out to be in error by a thousand-fold. All this is in the literature today. But it was discovered long after we committed ourselves to nuclear bomb testing, long after we built giant nuclear reactors on the assumption that linear was conservative and that it was probably in the other direction.

The tragedy has been not that people are evil, but that people were not knowledgeable enough because we just didn't have the knowledge or the understanding of the mechanisms of free radicals like O2-.

(Slide)

Now the question still is how do we know that cancers are changed in adults, because this is what Dr. Piccioni talked about? Well, again, Dr. Segi provided us with the data. He took the cancer data from all of Japan and corrected it for the growth and age of the population. It's called age corrected or age adjustment, and this is what he found for the whole period before the bomb and after the bomb, and you have to judge for yourself, assuming that Dr. Segi is an honest scientist, that there was no increase in cancer rates corrected for age for the total population in Japan from 1920 to 1950, despite their increasing industrialization and, in fact, they are getting ready for Pearl Harbor. They had to build battleships and submarines and had to have electric power plants driven by coal and oil. They had to have chemicals and chemical factories, and yet there was no increase in cancer rates. That is a remarkable discovery that has never been mentioned by the nuclear industry because coal was the only thing that gave us electricity before 1950. And yet cancer rates were not rising.

But within five years after the bombs of Hiroshima and the fallout from Bikini and the subsequent testing in Russia and Siberia, cancer rates rose all over Japan by 40 percent, and I drew here for non-white or Japanese, Chinese, black and Indian people of Asian extraction a curve for cancer rise in the U.S., and you can see it's even larger than that for the Japanese population. There are reasons for this which we are only now beginning to understand having to do with poverty and diet, but we'll talk about that later.

The important point is that it was a clearly recognizable effect and there was no question that here we have a situation where we don't have to. You know, we have to simply rely on models and extrapolations and

guesses. We have the statistics, but nobody had wanted to look at them. Well then, let's look at the other thing that we just heard about, namely, other effects. Well, one of the things that I discovered while I was at the University of Pittsburgh was, and in Pittsburgh working on radiation reduction for x-rays, that infant mortality suddenly stopped going down when bomb testing started. It's very simple.
For the white population it leveled off during the period of bomb testing and then resumed its decline afterwards, and, for the non-white population, it did it even more drastically with real peaks occurring clearly at the height of nuclear bomb testing in 1957 and '58.
(Slide)
Now the question is this really due to radiation, and this is a perfectly legitimate question. We produced a lot of DDT, we produced an awful lot of other things in the environment, and the question is how could we isolate it, and that's really the big problem. We have all kinds of chemicals in the environment which affect congenital defects, which affect cancer rates and there is no question that all these things combined are very serious for our society today.
But there was something that relates to what we're going to be seeing here, namely, the airborne release of relatively small quantities of strontium-90. This occurred during the time of nuclear bomb testing. And if we're willing to look at history and learn from it, then we need to look at the data. And what we should look at is something very far from where the bomb was detonated, like 2,000 miles away. There the radioactivity was relatively low and comparable to what we're going to get, or what we did get, from Three Mile Island and certainly much more than what we get from Chernobyl and Europe, but that is what we need to do.
(Slide)
We must now, in view of all the findings of Dr. Stewart, look at infant greater sensitivity in utero. And I've plotted here for you taken straight out of the U.S. Vital Statistics infant mortality in New Hampshire which, as you know, is very far from the bomb test site in Nevada. And here we see this steady decline of infant mortality and some jagged peaks followed by a further decline after the bomb testing ended. And I've also shown the number of kilotons of bombs detonated in Nevada 2,000 miles away tremendously diluted by the time it got to New Hampshire and thousands of miles away in the rain. Coming down with the rain in the mountains of New Hampshire, we see peaks that correspond exactly to the yearly releases of kilotons, not megatons, but kilotons in Nevada with small amounts, 20 or 30 picocuries per liter of strontium-90 in the milk at the time, and that compares with something like 100,000 picocuries per liter of strontium-90 in the water that is stored now here in your plant on Three Mile Island.
This was 20 to 30 picocuries per liter compared to 100,000 to a million now stored in the plant.
Now you can say what did the babies die of? I mean the radiation was clearly not very large. If I walked around with a Geiger counter, it would hardly click. Why? Because strontium-90 produces no clicks on the Geiger counter. Strontium-90 in the body produces only beta rays and there is almost no way to detect it.

In fact, one of the things that we worked on at the University of Pittsburgh are ways of trying to detect substances in the human body that don't give off a lot of gamma rays. It's very difficult. You can use all kinds of things, but it's very difficult to detect strontium-90 at the levels that are even now sitting in that tank. On the outside you get hardly anything. It won't go through steel and it won't even come out of the human body, out of the bone where it's concentrated.

So the trouble is that strontium-90 goes to the bone. The trouble is that there is where the bone marrow is, and the bone marrow is very important as we have only learned in the last 10 years. It protects us through the development of the immune system.

You will remember that many of the people at Chernobyl who were highly exposed were given transplants of bone marrow in order to try to save their lives because their own immune defenses had been destroyed. Dr. Wald himself was involved in treating people who were highly exposed to radiation by an accident, and the problem was to keep them from getting infected because it was infections that would kill them. He managed to save them.

This is why we need work in the field of radiation protection. There will always be workers and people highly exposed to radiation or accidents in a medical environment or in a laboratory where it's used importantly for biological research.

But in the process we learn that the immune system is really crucial. What we didn't know is that the immune system is so particularly sensitive to strontium-90.

Now one of the early indications that the immune system is involved is again something that you can see with your own eyes.

(Slide)

What I did here was I took the data on pneumonia and influenza among children zero to one year and had it plotted up between 1940 and 1975. Now these children died of infectious diseases in the U.S., and you can see that it was coming down nicely as we improved drugs and medical care and diet. But during the time of the nuclear bomb testing, it completely reversed. And only until after we ended nuclear bomb testing in precise coincidence did it begin to come down.

Now again I warn you explicitly that this does not constitute absolute proof. Do you understand? It's epidemiology in which there is no absolute proof. There is only a probability, a certain likelihood that this is due to radiation and not something else.

For instance, there were improvements in drugs in recent years that contributed to the decline. No question about it. But the improvement of drugs could not have produced an increase during the time of nuclear bomb testing, right? So you see that although there is never a simple single factor, we can arrive at the increasing that something should be of concern to us.

The tragedy about this is that many of us, including many of the people on the Board, myself, and other people had no idea about these things before 1950 or 1960 or even 1965 or '70. The trouble is that the advance of biological knowledge has outstripped our technology, and that is a problem.

Now we want to take a look at say well, but nuclear reactors is something different from bomb tests, right? Of course. They are carefully designed not to emit a lot of radioactivity. Some have accidents. Some are badly operated. Some have a design like a boiling water reactor which is worse than releasing more radioactivity because it has a single loop like the one at Peach Bottom than the one, shall we say, at Beaver Valley. The differ in their releases and they differ in their effect on the environment.

But the standards for radiation were set on the basis of what you heard - that the BEIR Committee did cancers in adults and not for death due to immaturity or infectious diseases in the newborn. The tragedy is that we didn't know about this when the standards were set, and when billions of dollars were invested in new plants.

The tragedy is that nobody knew, neither I nor Dr. Piccioni nor Dr. Wald nor Mr. Gerusky, none of us could anticipate back in 1950 or '60 when we went to school that these kinds of effects would turn up 20 or 30 years later. Nor did people know about asbestos when they insulated all the school buildings with asbestos, nor did they know about DDT when they tried to defeat malaria that it would have these deleterious effects, or PCBs, which was a great thing for transformers, that it would have such a biological effect.

The tragedy is that the particular contaminant we are talking about, unlike PCBs, makes atomic bombs. That's what our federal government is interested in and that is what the NRC is primarily concerned with and the Atomic Energy Commission and the DOE from which they sprang. They were responsible for the security of this nation and it was felt imperative that we had to have plutonium and that it had to be produced at a reasonable cost.

ARTHUR MORRIS: Dr. Sternglass, in all fairness I realize that this is a subject matter that I'm sure you could speak on for hours as background. It is important to try to get to the point. It's 25 minutes into your presentation and we had you scheduled for 30 minutes. We can be a little flexible in that but ---

ERNEST STERNGLASS: Fine. I try to finish in five minutes or so.

ARTHUR MORRIS: Well, if you need a little longer, fine, but we hope we have a chance to ask you some questions.

ERNEST STERNGLASS: Absolutely.

(Slide)

Now what we looked at is strontium-90 around a nuclear plant in Connecticut, and the levels near the plant as measured by their own people were higher than it was during the height of nuclear bomb testing in Connecticut. It centered right on here. When I showed this to the NRC, or the AEC at that time, they said this was Chinese fallout.

(Slide)

This is what happened to the cancer rates around that plant, and you can see that, going away in every direction, the greatest cancer increases occurred where that plant was located, directly taken out of U.S. Vital

Statistics and the State of Connecticut Statistics as published in an article by the Environmental Policy Center.

Now we quickly return to Three Mile Island. Now, you remember there was a question about infant mortality had really changed. Now, by 1983, we see that it never returned to its baseline in the United States even though nuclear testing stopped. But in areas like Wyoming where there was no nuclear reactor, infant mortality returned to its projection of about 60 percent of the total U.S. value because there are no nearby nuclear test sites and no nearby nuclear reactors.

So you see that you have to decide whether or not there is something to worry about. This is Pennsylvania compared with Maine and infant mortality declining. Maine was higher. Then during the time nuclear bomb testing both leveled off. But after nuclear bomb testing, Maine declined sharply and Pennsylvania hung up there because we did not know how serious radioactive releases were and they were high. So that infant mortality rose relative to Maine and only after the Three Mile Island accident did it suddenly drop from 13.2 to 9.8 in two years, a 20 to 30 percent drop when the source of pollution was shut off.

As you can see, whenever one has such a situation, one has the suspicion, the probability, that when you shut off a certain source that the effect declines, as it did with the cholera epidemic in London, then this is likely to be causal related.

Again, it's not proof.

But now let's look a little closer at Three Mile Island. You remember where it is located relative to the other states, Connecticut over here, New York up here and Ohio in the other direction, and Maine. It drifted all over New England and up into the north. So we should see the effects everywhere, shouldn't we? - if there were distant effects the way there were from bomb testing.

Well, here it is in Maryland, and here you see a decline in infant mortality followed by a rise as in Wyoming and then a decline and then we see a black area. This black area represents retrospective correction of the originally important infant mortality in subsequent issues of the U.S. Monthly Vital Statistics.

And when the final picture was in three or four years after the accident, there was a clear peak at Three Mile Island and the official U.S. Monthly Vital Statistics, and after years of correction, the truth finally came out.

In fact, here in this area as just one example, this shows you what infant death rates according to the Pennsylvania Health Department's report happened during the time for infant death rate for portions of South Harrisburg that lay within a 10-mile radius for the April-June quarter, which is the quarter in which the accident took place, and you can see that between 1978 and 1979 there was a rise of 158 percent in that death rate.

Now you have to ask, but is this all? No. In Maryland we see during the time of the release that Dr. Piccioni's group warned us about a clear rise from 58 to 124 deaths a month which I'm sad to say had disappeared the next year from the next issue of infant deaths for the U.S. Monthly Vital Statistics.

Finally, let me show you what happened in upstate New York.

(Slide)
In upstate New York, we had three giant peaks during the 1979 year period every month. That's because, on occasions, the wind would blow north here and here and here, and we got these enormous statistics going from 145 deaths up to 220, a highly statistically significant change because these are one sigma error bars. One sigma means that it is a one -- roughly a chance equal that it is an error -- it's simply a statistical fluctuation. So when you have two or three or four statistical errors, or a peak of that size, it is highly unlikely that this is accidental.
Finally, let me come to what is regarded in my mind as a most important piece of evidence.
(Slide)
We collected from the U.S. Monthly Vital Statistics the death rate for infant deaths from 1970 to 1983 and plotted it for every month right out of the U.S. Monthly Vital Statistics, and now you will see what a tremendous data base we now have.
We see fluctuations seasonal, generally higher during the winter and lower in the summer. We plotted the Chinese bomb tests and there is no real strong evidence that the Chinese fallout produced anything.
Furthermore, a reactor similar to the Three Mile Island one began operating in late '78, but it had a lot of troubles and it operated in the northern part of Ohio. So it didn't have many releases and when they let them go it mostly went to Canada. So you see there isn't very much in the way of any evidence.
But now let us compare this with upstate New York over which we know the Three Mile Island drifted and here we see the following.
(Slide)
Let us first look at the first part, and you see like Ohio there was nothing unusual in upstate New York. It showed the normal seasonal variations. But finally after Three Mile Island went on line, we see an increasing number of giant peaks, and then during the time of the accident three more peaks, and then during the time of the venting three more peaks and then a decline to an all-time low of only 4.9 cases in the latter part of '79 compared to 27.4 per thousand or 276 cases versus 53, a highly significant decline.
More than that there was another peak that we discovered by accident in '82 and it was associated with a known break of piping between the primary and secondary loop in Ginna reactor in Rochester, New York.
Finally, what does it all tell you? The point is I cannot tell you what this means. I cannot make up your mind whether to believe the projections of the industry and the NRC and the AEC that gave the blessing to the bomb testing and the design of the reactors or to independent scientists like Dr. Burtelle, Dr. Bruce, Dr. Piccioni, myself, and numerous scientists all over the world who were not connected with the industry.
We each have our biases. I certainly would always say that I strived all my life to find ways to reduce x-ray doses to people, but I'm fallible. The real point is that you have to decide in the light of probabilities like a jury, not whether there is absolute certainty that I'm right, but only whether it is possible that I may be right.
Thank you.

(Applause)
I'll be glad to answer any questions.
Also, let me say that I have for each of you copies of a paper that I just published that contain many of these graphs. I will also distribute among you copies of some of the key graphs that I just showed you so that you can take them home and ponder over them yourselves.

ARTHUR MORRIS: Thank you, Dr. Sternglass.
Maybe if you would like to return to the table and see if there are any questions.
Joe.

JOSEPH DiNUNNO: I have a couple of questions. I think he should stay there to put a couple of his viewgraphs back up. I'm just trying to put into perspective the data that he presented versus the kinds of releases that were being talked about in terms of this water problem that we're trying to develop. I'm trying to find the relationship between what I heard and the issue before the table.

ERNEST STERNGLASS: Well, I'll be glad to address it.

ARTHUR MORRIS: Before we do that, if we could let's realize that we are here to discuss really the disposal option and the PEIS.

ERNEST STERNGLASS: I just simply had to set it into perspective that a projected release which was presumably comparable to the venting that was believed to be safe of some 50,000 curies of noble gases back in '80, and that release, as you may remember, and on the material that I'm giving you showed a clear peak of infant mortality in the second half of 1980 relative to the first half.
That's what I'm trying to do, to show you that historically what was believed and was advertised by the industry and guaranteed to be absolutely safe so that the people who objected to it were poo-pooed, okay, that they were right and that we have indeed underestimated the effect.
I'm saying we need to look at old history in order to learn from the past or else we will have terrible problems if we do not examine the past history.

ARTHUR MORRIS: Joe.

JOSEPH DiNUNNO: Just two points that I think I would like to have you address. The curve that you were showing, the curvalinear dose and the linear relationship, I quickly noticed the abscissa, the numbers on the bottom and they went from zero in effect up to 100.

ERNEST STERNGLASS: Right.

JOSEPH DiNUNNO: But those curves converged pretty much down in the 10 rad area. If you look at that curve, that suggests a great deal of uncertainty once you get down in the millirem and fractional millirem

that would be involved in this release. You're informing people of what you suspect or what you would theorize happens at very high dose levels, but you have to address for their benefit the uncertainties that are involved once you get down in that very low range.

ERNEST STERNGLASS: I'm glad you asked that question.
(Dr. Sternglass returns to the slide projector)
(Slide)
I'm sorry. I have so much more material that I was unable to show you. But here is a curve taken from data by Dr. Stocke and his co-workers at Oslow Cancer Hospital published in about 1968, and it shows the strontium-90 does to bone marrow in millirads for rats in which he injected small amounts of strontium-90 at levels comparable to the ones we're going to expect here at Three Mile Island.
This is a percent depression in bone marrow cellularity that he observed, and you can see that it rose very rapidly, just like the other curve I showed you, at very low doses and then leveled off at high doses.
Now at the time we did not understand it. In fact, we extrapolated and expected to be down here. But the actual effects that he could see microscopically in the rat bone marrow was as much and so clear that there is no question now that we totally underestimated the effect of free radicals at very low doses. And that is the problem of the advance of science when our technology is frozen in.
The reference to this is given in the article that I've just distributed to you.

JOSEPH DiNUNNO: One other question while you're there, Dr. Sternglass. You also presented a large amount of data to begin this off dealing with the effects of radiography, the use of x-rays.

ERNEST STERNGLASS: Right.

JOSEPH DiNUNNO: But there are no indications of dose levels that are associated with those. So they lose something there.

ERNEST STERNGLASS: Exactly. A typical x-ray gives about 200 to 300 millirems to the fetus. We are talking about background radiation levels of about a year and a half worth of radiation.
Now for the case of the fetus of the first trimester in the embryo the slope is ten times greater and we are talking about a doubling dose of about 90 millirads. Now more recently, just now, and I'll be glad to show you a copy of the paper, Dr. Alice Stewart did a study on the effect of background radiation on leukemia and cancer in England and discovered from measurements of background radiation all over England, a paper she just presented at an international meeting, that 90 percent of the leukemia and cancer among newborn can be attributed to background radiation and only about six to seven percent to medical x-rays.
So we are talking about a doubling dose of a first trimester of only 40 millirads. That means that if the three millirads to some group of the population which is admitted in the volume that we have seen of the environmental impact statement, then we would expect a certain increase,

proportionally a 10 percent increase in leukemia and cancer rate among the children.
And since about 2 million children, or 2 million individuals will live within the 50-mile radius and about 10 million within a 75-mile radius, we certainly would expect something like 20, 50 or a few hundred infant deaths of which possibly 1 to 10 percent would be leukemias and cancers. So we have data at the low dose level of what we're talking about.

JOSEPH DiNUNNO: Isn't it true, however, that the data that you have at these lower levels becomes more and more speculative as you go down?

ERNEST STERNGLASS: No, not at all, because there was a very careful study d e in England by the Public Health Service of the British Government. They studied the radiation levels every 10 kilometers all over England and Wales, and Dr. Stewart had accumulated the evidence on 16 million women who bore children in England and Wales since about 1950.
Her data now shows that in every area like London, areas that have low background radiation had a low incidence of child leukemias and cancers and areas that have high measured levels of radiation had almost twice the incidences. So we are talking about an extremely carefully done study that involved close to somewhere around a few hundred million man-years, person-years, of radiation followup, the largest study of its kind.

ARTHUR MORRIS: I see John's hand and then Niel. Was there another one here? Okay.

JOHN LUETZELSCHWAB: Let's go back to the 1976 Chinese bomb test. I had sampled my garden as a matter of fact and I found iodine, lanthanum, and some cesium, of course, that was there from years ago, too, and I assume there was Strontium 90, but I didn't check for that because I can't do that. I was measuring gamma radiation.
Yet it doesn't show up in any of your data. I'm surprised because the levels I assume that came from that test that blanketed New York and Pennsylvania were much, much higher than came from the accident, from the venting or anything. Why don't you see that on any of your statistics here?

ERNEST STERNGLASS: As a matter of fact, I presented a report, and I'll be glad to give you a copy of it, to the National Academy of Sciences on the October 1976 Chinese fallout. It's referred to in the BEIR Report. And in there I showed that all along the coast of the United States during the time that we monitored that terrible fallout from the October '76 cloud there was a 20 to 50 percent increase in infant mortality per month during each month beginning about the second to fourth month after the fallout arrived.
It was not observed in Massachusetts where they had taken the cows off pasture, and that report I'll be glad to send you a copy of.

JOHN LUETZELSCHWAB: But that's just iodine. What about strontium-90 which is in the food---

ERNEST STERNGLASS: At the time we don't know all the doses, but my correlation at that time was carried out with iodine. And we don't have to forget that there will be iodine released. We are talking about I-129 at least as one of the isotopes that goes to the thyroid, and the amount of iodine-129 is much more damaging in the long run that I-131 because I-129 has a half life of 16 million years and will be recycled again and again in the soil and in the animals that die and the food. Again and again over the years we will have effects due to this I-129 that you propose to release.

ARTHUR MORRIS: Niel.

NIEL WALD: A couple of questions, but first a comment. It's nice to see that we picked a good lecturer when we brought Dr. Sternglass to the University of Pittsburgh. Of course, we brought him as a radiation physicist and not a biologist or epidemiologist.

The work of Alice Stewart that you've mentioned, and you've leaned rather heavily on your dose estimates of what these x-ray studies involved in the way of radiation exposure, but, unfortunately, these were not reported or measured by anyone at the time, and the number of x-rays is the recall of the memory of the mothers who were surveyed. They were asked how many x-rays were taken, and this is a very solid basis on which to draw a dose response curve and then insert a dose estimate which was to replace the missing dosimetry.

In other words, what I'm saying is that you can't lean as heavily on data -- more heavily than the data itself justifies. While this is an interesting epidemiologic study, there are some problems with it, this being one of the major ones.

Another major one is that the finding should have led, if it was correct, to an increase in the incidence of leukemia in the children who were exposed in Hiroshima and Nagasaki who happened to be in utero at the time of the bombings and that increase has not been seen. So it is not a uniform finding.

I think the figure she used, incidentally, is not 50 or 100 percent, but 40 percent I think was her best estimate.

On Petkau's work I believe that the membranes that he worked with were artificial membranes rather than actual living cells, and while I certainly think it's interesting work, it's a little hard for me, again with my health perspective, to jump from an artificial Mylar film like Saranwrap and consider that the same as the cells that we're made of.

ERNEST STERNGLASS: I'm sorry, it was not Saranwrap.

(Laughter)

It was beef brain lipids. It was living tissue lipids. Furthermore - are you finished? Why don't you give me a chance to answer the questions. I keep forgetting what you're asking. Let me answer one at a time.

NIEL WALD: I had to take notes to make sure I didn't forget what you were saying and I'm not talking nearly as long.

ERNEST STERNGLASS: You want to put me at the same disadvantage, right?

NIEL WALD: The other point you made about free radicals. I'm just a little troubled because that was something that was recognized many, many years before 1970 and indeed there was a search, as you are probably familiar with, with agents that absorbed free radicals.

ERNEST STERNGLASS: Sure.

NIEL WALD: And as you mentioned, the cells have natural agents which do that. The problem of cancer rising, Dr. Segi, is that --.

ERNEST STERNGLASS: Segi, yes.

NIEL WALD: -- is a complicated one. For example, if antibiotics get introduced into an area which didn't have them, then there will be other causes of death that have to increase because all of us must die, and these changes, it is again an extrapolation or a model, a mental hypothesis which says this is due to radiation, and it may or it may not, and most likely it's a lot of things rather than any one thing.
I make that caution in looking at cancer deaths. For example, all over the world the incidence of leukemia started increasing around 1930, including Japan. That I didn't see demonstrated on this graph and the reasons for this are not clear, but this was a period during which the increase was noted in very many countries all over the world.
So that one has to be careful about drawing conclusions about the cause when one detects a change as the kind that Dr. Sternglass demonstrated.
The background studies of Dr. Stewart, did you give a reference or was this a presentation and has been published?

ERNEST STERNGLASS: The paper is now being published.

NIEL WALD: I haven't seen it. So it's hard to comment since it hasn't come out yet.

ERNEST STERNGLASS: I'll be happy to show you a copy and send you a copy.
So let me try to remember now all the things that you mentioned. Let me work backwards.
Dr. Alice Stewart did indeed have this help from the National Radiological Network in order to determine background radiation everywhere. So that is now a very different question because the dosimetry is well known, unlike in the case of x-rays that had to be reconstructed.
Fortunately, in my business, we know roughly what a dose is during a given time because other people were measuring the doses.

NIEL WALD: I wasn't questioning this one. I was simply pointing out that none of us have seen it because it hasn't been published yet.

ERNEST STERNGLASS: Right.

ARTHUR MORRIS: Let's do this so we can make some sense.

ERNEST STERNGLASS: Let me finish.

ARTHUR MORRIS: Let me just try to set the game plan here. You made a presentation and we have had a counterpoint. You go ahead and make a point. If Niel wants to make an additional point, I would ask him to do it very briefly so that we can have another opportunity for other people.

ERNEST STERNGLASS: I understand. So let me now address a question of the cancer rates in Japan.

Again, the fact that it recently leveled off and has begun to come down, both for leukemia and total cancers means that despite the increase in pollution and the use of new drugs that there is indeed a decline or a leveling trend in Japan in general, and Japan has now and Iceland and Denmark have lower cancer rates than we do and they are declining while in many parts of the U.S., cancer rates are still increasing.

All we can always say is there is no question that nothing can ever prove it beyond a shadow of a doubt, and there is also no question that the presence of other chemicals will also have an effect just like workers in the uranium mine when they smoke get much greater increases in lung cancer rates than when they don't smoke. So there is no question that there is an interaction or synergistic relation between radiation and cigarette smoking.

Now let's go back to another question that has to do with the amount of radiation given during x-ray procedures. Dr. Alice Stewart had a number of studies done at the time that showed what the typical x-ray dose was, and what is significant is that it is the number of x-rays that increased with the dose.

Furthermore, Dr. Brian McMahon who raised the same question as Dr. Niel Wald did, repeated Dr. Alice Stewart's study at this time with actual hospital records of the number of x-rays given in New York and New England, and he completely substantiated Dr. Stewart's findings although in an absolute sense, he got about 40 to 50 percent as great an effect because of the further improvement in medical diagnostic techniques and the speed of film and so on. But in his case that study answered it.

Furthermore, Dr. McMahon and his associates addresssed the question as to why it was not seen in Hiroshima as did Dr. Stewart. We have to realize that Dr. Stewart had to look at 16 million women in order to discover her effect, but in Hiroshima only a few hundred women survived and had children that were followed up.

And Dr. McMahon himself and Dr. Stewart showed that those few hundred babies that happened to be in utero at the time and survived were too small in number to detect the effect. You literally have to look at millions of cases in order to be able to see it.

And I think these are the kinds of considerations that you have to question yourselves. If you have a family and you expect a baby, what would be your concern. That is what you have to think about, and you have to express your concern in that area and you have to judge between the kind of evidence that Dr. Stewart presents, the kind of evidence that now comes from the University of Colorado showing that in July of last

year in the National Academy, there was a 200-fold greater response of human chromosomes to environmental radiation, to lower levels of x-rays than we had ever expected.
Now this is new data. No one can blame us or anybody for not having known about it 10 or 15 years ago. All I'm saying to you now is do not disregard the latest scientific data because it goes against what we had hoped for in the nuclear industry.
[Discussion]

ERIC EPSTEIN: I'm Eric Epstein from Three Mile Island Alert.
What I want to do in order to save time is I have a statement from Michio Kaku. I'm going to read that, and I think my own statement, which is really brief. Should take 10 minutes.
So let me begin by reading Michio's statement verbatim, and I don't want you to confuse his credentials with mine.
Statement of Dr. Michio Kaku concerning the disposal of TMI waste, and this is Michio again speaking.
I am a full professor of nuclear physics at the Graduate Center of City University of New York. I graduated from Harvard University in 1968, Phi Beta Kappa, Summa Cum Laude with highest honors and No. 1 in my physics class.
I received my PhD in nuclear physics at the Lawrence Radiation Laboratory at the University of California at Berkeley, 1972.
I subsequently taught on the faculty at Princeton University and I've been a professor with the City University of New York for the past 14 years.
I have published over 45 articles which are right here if you need to see them for the record and various professional journals and contributed to over six books.
I am the author of Nuclear Power - Both Sides which has since become the standard reference on the nuclear debate and my credentials are enclosed at the back of this statement, and I would move that he be accepted as an expert witness.
I'm going to also when I'm reading some of these abbreviations read them rather than screw up what they might stand for. It's for some of the transuranics and the elements, if that's okay as well.
I have been asked to review the NRC's plans to dispose of TMI waste water as presented in a supplement to the Environmental Impact Statement, Supplement NUREG-0683.
I find several things disturbing about the presentation from a strictly professional point of view. Previous EISs concerning the disposal of radioactive wastes have totaled more than a thousand pages with scores of charts, diagrams, graphs and tables.
In comparison, I find the present NUREG 0683 deficient. It does not reflect careful scientific scholarship and it seems to have been slapped together at the last minute. Many key areas of scientific information seem to have been carelessly left out, making it difficult to make an accurate scientific analysis of its credibility.
The report verges on sloppiness and I hope it does not reflect a deeper attitude towards the clean-up operation. I will list some of the areas

that I feel are lacking in scientific rigor and reveal a certain amount of hastiness.

No. 1. The list of radionuclides on Page 2.3, Table 2.2 is a very poor indication of actual radiation inventory of the water. For example, compare it with Pages 7-5, 7-6 and 7-7 of the original EIS published six years ago and we find that the current list omits many important radionuclides originally tabulated by the NRC.

Some of the radionuclides that are left out by the NRC in the current volume are important, including, and here again here are the abbreviations, MB/95, ZR/95, SP/125, TM/125M, TE/127M, TE/129M, CO/58, TE/I/129M, RU/103.

Thus, it is difficult to evaluate the present EIS supplement because it is deficient in this important analysis. This is a significant point because there were literally hundreds of radioactive chemicals dissolved in the reactor building and sump water making it a virtual soup of radioactive elements.

The ion exchange mechanism of the SDS and EPICOR II does not filter all elements identically (and, in fact, does not filter some elements like tritium at all).

So we must have a careful reading of precisely what all is presently in the water compared to what it contained in '81 when the first EIS was compiled.

Point No. 2. Even though the original EIS of March '81 failed to make a complete radiation inventory, for example, neglecting to compute the transuranics contained in the water, in a normally functioning 1,000 megawatt reactor, for example, the accumulated high waste within 100 tons of uranium dioxide is about 30 tons of which 500 pounds consists of plutonium.

Most of the plutonium is reactor grade plutonium-240. Most of these transuranics are not water soluble compared to iodine or strontium. However, they certainly exist in the water.

I mention them because the transuranics are some of the most toxic chemicals known to science. The low levels of concentration in the water are compensated by the fact that they are quite toxic. Yet no mention is made to them in either NUREG 0683 of six years ago or the present EIS.

Point No. 3. No mention is made of how the radioactive levels in the water were obtained. Given the fact that the original radiation inventory exceeded half a million curies, this is not a trivial question. Thus, it is impossible to give a detailed assessment of the accuracy of the radiation levels because no indication is made of how these measurements were taken and how reliable they are.

Statements of the willingness of utilities to drink this water are not scientifically relevant and in fact are misleading. I refer you back to Herman DeCamp's quote that the water is so lowly radioactive that he would drink it.

FROM THE FLOOR: Give it to him.

ERIC EPSTEIN: We'll give it to him.
(Laughter)
Where is Herman tonight?

Point No. 4. The tritium count in the water raises some concerns. Originally there was 2500 curies of H-3 in the reactor building sump water. The EPICOR II and the SDS of course cannot extract out the H-3. The filters work on the principle of ion exchange as in a water softener. So that H-3 cannot be removed.

However, the present EIS only lists 1,020 curies of H-3 on Table 2.2. Where did the other two-thirds of the tritium suddenly disappear to? Normal radioactive decay cannot account for this because H-3 has a half life of 12.3 years. No mention of this discrepancy appears in the EIS. The present EIS gives a misleading interpretation of the properties of tritium on Pages 2.5 and 2.6. At best, it is self-serving and at worst, deceptive.

The EIS only takes selective quotes from the NCRP, the National Council on Radiation Protection Measurement and omits others which may show the hazards of tritium.

For example, the EIS quotes the HTO has a 10-day biological half life in the body, but neglects to say that HTO can also be incorporated directly into cell membranes where it becomes a rather permanent part of the body's chemistry. Thus, the radioactive HTO can irradiate body tissue over the life span of the individual causing possible radiation damage. Thus, the figure on the biological half life in the body is not indicative of the actual body burden of radioactive materials one may incorporate into human tissue. Yet, no mention was made of this.

Some rather feeble attempts were made to calculate radiation exposures to the tritium at a distance, but no attempt is made to calculate tritium that is incorporated into the body itself and, hence, irradiates the body at a close range.

Point No. 6. Because water is everywhere in our environment and since HTO is chemically identical to water, the pathways for ingestion or inhalation of this water are non-negligible.

Because the utility is making preparations for a possible boil-off of this water into the air, it becomes a significant question of how much of this water will eventually become ingested into the human population. Boil-off, evaporation or river dumping all have the same net effect of releasing HTO into the environment where it can be picked up by living organisms.

I find the analysis of how much radiation can be ingested in humans from an evaporation or boil-off wholly deficient in the report. It appears as if the authors of the report simply dashed off this section on environmental and health hazards as an afterthought.

Point No. 7. The EIS does not mention that the radiation standards for beta radiation may soon be changing. The T-65 dosimetry, which was originally used to calibrate the radiation from the Hiroshima bomb, is not known to have been miscalibrated.

Recent work done at the Livermore National Laboratory which designs hydrogen warheads has shown that neutron levels probably cause less biological damage than previously thought, but that electrons and gamma rays do more damage. This is significant because the Hiroshima data is perhaps the largest of all the epidemiological studies on radiation health effects outweighing all the others.

A recalibration of the Hiroshima data with the correct numbers for beta radiation may show that chemicals like HTO are more dangerous than previously thought, forcing a revision of the NCRP data. Yet no mention is made of this in the EIS.

Point No. 8. The NRC makes no mention of the reliability of the vendors and companies which may eventually carry out the release of this water into the air or river.

Normally it is not that essential that the EIS address this question. However, given the rather unsavory documented history of past deception, some of it conscious and some of it bordering on the criminal, it is not too much to ask the NRC to thoroughly evaluate the reliability of these companies and the role of the utility.

Point No. 9. Not enough attention is paid to the negative effects of river dumping, both commercial and environmental. As an example, consider the fact that 90 percent of the value from Chesapeake fisheries comes from shell fish, a luxury item for many restaurants and hence, highly subject to people's perceptions of how safe it is to eat the shell fish.

The well-publicized dumping of the insecticide Capone and other pollutants in the 1970's in the Chesapeake caused enough negative impressions for the consumer to have a sizeable economic effect on the Chesapeake economy. The adverse effect on the sale of oysters and blue fish is well documented causing an economic loss to the area.

Dumping of TMI waste water into the river could very well have a negative effect on the economy of the area given the fact that much of the economy rests on the luxury items that are highly susceptible to changes in people's tastes.

Point No. 10, and the last point. In summary, I find the present supplement to the EIS is not very valuable from a scientific point of view. The NRC has not done its homework and it's hard to make a reasonable scientific conclusion given the paucity of scientific information contained in the report.

At best, it shows a certain insensitivity and a lackadaisical attitude towards radiation safety and at worst, it shows an inclination to disregard the health and safety of the people in Harrisburg.

That is the presentation of Dr. Michio Kaku. I might have read it too quickly and I hope you were able to all comprehend it.

Since I am not a technical expert, I'm not disposed to answer any questions you may have. But what I will do is make some copies available perhaps at a later date to the Commission because I think Dr. Kaku is a reknown world expert and I think his opinion is much valued.

[Discussion]

ERIC EPSTEIN: I'm just going to make a brief statement because I think I've said all that I really wanted to say at the other meetings. I just hope for a change that somebody from an NRC-affiliated body listens, and that would be a delightful change to past actions of the NRC in the past.

I'll just read briefly.

We've gotton so used to being ignored and having NRC-affiliated bodies rule against us that I appear here tonight hoping for once that a decision will be rendered in favor of the residents of Central Pennsylvania.